Third National Conference on Waste Management in Canada

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PANELISTS' OUTLINES

The Third National Conference on Waste Management in Canada was co-sponsored by:

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Ontario Solid Wastes Management Association
(NSWMA)

Province of Ontario

Conference management in Toronto was provided by SDA Communications.

This publication is a collection of the available panelists' outlines prepared before the conference.

The following are the outlines of panelist presentations received in time for distribution at the Third National Conference on Waste Management in Canada. Panelist's presentations at the conference were substantially based on these outlines.

Additional information regarding the panelists and their presentations may be obtained from:

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The Steering Committee of the Third National Conference on Waste Management in Canada wishes to record it's appreciation of the efforts of the panelists for preparing the outlines of their papers and their subsequent delivery and to the panel moderators for guiding panelists and audience during the conference sessions.

K.A. Childs
Conference Chairman

October 14th - 10:40 - 12:10 p.m.

Collection

Moderator: Ron Murray
Superior Sanitation Services Inc.
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Panelists: Robert P. Stearns
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(productivity)

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IMPROVING RESIDENTIAL SOLID WASTE COLLECTION SYSTEM PRODUCTIVITY

Presented at the
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IMPROVING RESIDENTIAL SOLID WASTE COLLECTION SYSTEM PRODUCTIVITY

Solid waste collection comprises approximately two-thirds of the cost for residential solid waste management. Despite the fact that collection is twice as costly as disposal, government and industry research and development efforts have been largely devoted to resource recovery and/or disposal. This lack of emphasis on developing more efficient collection techniques, in conjuction with administrative neglect, has fostered inefficient, and excessively costly collection systems in many locations.

In light of the existing economic climate, residential collection systems, particularly those operated by government agencies, are being challenged to show their effectiveness and productivity. In addition, privately owned and operated systems are under constant pressure to hold down costs in these days of two digit inflation. With this background, this paper will outline techniques to measure the productivity of existing collection operations; and, based on those measurements, identify and evaluate means to improve productivity.

THE PROPOSED APPROACH

The hypothesis upon which the methodology advocated by SCS is based is that there is little difference in the speed at which collection crews work. Rather, differences in the overall daily productivity between crews stems primarily from: 1) methods and equipment utilized to do the job; and 2) the portion of the total workday actually devoted to productive collection activities. Therefore, increases in productivity are not predicated on making collection crew members work harder or faster; but instead result from the application of different equipment and/or collection methodologies which either reduce the time (and physical work) required at each stop or increase the total time available for productive activities.

In view of this hypothesis, the methodology utilized by SCS requires identification of those factors which make up the unique local collection situation and subsequent economic analysis of economic impacts of applicable alternative systems. A description of the methodology and an example of its application in the "real world" follows.

THE COLLECTION SITUATION

The factors which affect the productivity and subsequent cost of residential waste collection make up what can be termed the "collection situation".

The "collection situation" is defined as a geographical area where similar collection conditions exist. These conditions may be grouped as follows:

- Community characteristics, e.g., frequency of collection, point of collection and crew size;
- Laws and regulations, e.g., GVs and axle loading limitations and overall height and width restrictions; and
- Service area characteristics, e.g., topography, street/alley widths, and housing density.

A collection situation may be as small as a single collection route, or encompass an entire community. Meaningful comparisons and estimates of productivity must take into account all of these collection conditions.

Community Characteristics

The people served by a residential collection system comprise a community. Community characteristics impose important restrictions on the collection system. The community related restrictions can be classified as either economic, social or political.

The economic standing of a community has been shown to affect the quantity and composition of its refuse. Thus, a significant difference in per capita income typically results in varied refuse generation and composition.

Community social characteristics often influence, and consequently, play a role in, collection system selection. The significance of social impacts is apparent when changes in the existing system are proposed (e.g., the acquisition of innovative vehicles may conflict with community tradition or values). Communities which are conscious of air pollution or resource recovery may place appropriate restrictions on the selection of new collection methods or equipment. Tradition may cause objection to changes in crew size, equipment, the level of service, or pickup location.

Local politics may have a direct influence on operating conditions, since proposed alterations in the collection system are normally subject to approval by local government. Where collection is unionized, changes in the collection system may be subject to union approval such that proposed manpower reductions and expected productivity increases receive careful scrutiny.

Laws and Regulations

The solid waste collection manager must also be concerned about various guidelines and regulations applicable to residential solid waste collection. Standards relating to waste collection have been promulgated on both the local and national level by government and private industry alike.

Typical standards and regulations relating to refuse collection include the following:

Federal--

- Safety Standards (ANSI) (OSHA)
- Safety Regulations (DOT)
- Noise Regulations (EPA/DOT)
- General Storage and Collection Standards (EPA).

State and Local--

- Labor regulations - hours and conditions of employment
- Bridge weight restrictions
- Road and traffic laws.

Service Area Characteristics

The physical location in which residential collection equipment must function is defined as the "service area". The service area encompasses the collection route, haul route, and disposal site. Parallel consideration must also be given to operating policies and climate. All service area characteristics affect selection of the most appropriate collection vehicle/crew size combination for maximum productivity.

Table 1 presents a "check list" of service area characteristics that affect residential refuse collection performance. Table 2 is a sublisting of characteristics considered to be more important to collection vehicle selection.

"Climate related" service area characteristics and topography are unalterable physical constraints. Similarly, "service level" and "collection methodology" related service area characteristics listed in Table 1 are typically unalterable, since they result from political and/or administrative decisions which reflect community characteristics. All of these characteristics are essentially "givens" which merely define and categorize the collection situation.

THE IMPACT OF ROUTE RELATED SERVICE AREA CHARACTERISTICS

The "route related" service area characteristics listed in Table 1 are of primary concern in measuring, comparing, and

TABLE 1

SERVICE AREA CHARACTERISTICS AFFECTING REFUSE COLLECTION PRODUCTIVITY

Service Level Related

Collection Point

- Alley/Curb
- Curb
- On-Property

Collection Frequency

- Once/week
- Twice/week
- Other

Waste Material Collected

- Type
- Maximum Dimensions
- Seasonal Variation

Route Related

Containers

- Number
- Type
- Size
- Weight Limitations

Distance between Collection Stops

Quantity of Refuse per Collection Stop

Haul Distance to Disposal Site

Maneuverability Constraints

- Vertical
- Horizontal

Topography

- Collection Route
- Haul Route

Delays

- Traffic
- Parked Cars and Other Obstacles
- Congestion at Disposal Site
- Container Accessability to Crew
- Compaction Cycle

Road Conditions

- Type
- Speed Limits
- Load Limits

Collection Methodology Related

Crew Size

Collection Procedures

- Compaction Policy (if any)
- One Side of Street/Alley with One Pass
- Two Sides of Street/Alley with One Pass
- Driver Assistance to Loader

Climate Related

Wind

Rain

Ambient Air Temperature

Snow and/or Ice

TABLE 2

SERVICE AREA CHARACTERISTICS MOST IMPORTANT TO EQUIPMENT SELECTION

Service Level Related

Collection Point
- Alley/Curb
- On-Property

Collection Frequency
- Once/week
- Twice/week

Type of Material
- Combined Refuse
- Separated Material

Route Related

Containers (No.)
- Conventional Cans
- Disposable Items

Distance Between Stops
Quantity of Refuse/Stop
Haul Distance

Maneuverability Constraints
- Horizontal Clearance

Topography
- Haul Route

Road Conditions
- Type
- Load Limits

Collection Methodology Related

Crew Size

Collection Procedures
- Compaction Policy (if any)
- One-Side, Two-Side Collection
- Driver/Loader Assistance

Climate Related

Ambient Air Temperature

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improving productivity. The number of tons or units served per crew per day is significantly impacted by the route-related characteristics of the service area.

Productivity analyses and comparisons quoted in the literature have historically neglected to take into account the differences in route related service area characteristics between communities. As a result, the literature is full of misleading comparisons of productivity between cities. These studies have often implied that differences in productivity stem primarily from differences in worker motivation rather than from differences in the collection situation and the equipment utilized.

To make meaningful comparisons of productivity, and more importantly, to identify means of improving it, requires identification of and accounting for all of those "route related" characteristics listed in Table 1. The fact that this requires actual observation of collection operations in the field, is the probable reason why route related characteristics are frequently neglected by productivity investigators.

MODELING COLLECTION PRODUCTIVITY

The authors have long felt that collection could be modeled, i.e., that for a given crew size/equipment type, the time required to service a stop could be predicted if values for the most important route related parameters were known. Obviously, such a model would be highly desirable, since it would allow "experimentation" in the provision of the collection service, i.e., it would allow managers to predict changes in productivity due to changes in the parameters.

Assuming that direct relationships do exist between the productive time required to service a stop, and route related characteristics, they can be identified using linear regression analysis. Linear regression merely quantifies the cause and effect relationship that may exist between phenomena, i.e., as hypothesized in this case the productive time required to service a stop is dependent upon route related parameters, such as the distance driven from the previous stop, as well as the number and type of items collected at that stop. To document this hypothesis, events are observed and related; and, on the basis of subsequent analysis, a decision is made whether the results are related causally.

Statistical analysis of thousands of field observations by the authors confirmed the hypothesis of the relationship between productive time and the following route related characteristics; distance between stops, and number of each type of container.

Models were subsequently developed to allow accurate estimation of the productive collection time required to service one or more stops for several combinations of crew size and type of collection equipment used, e.g., one man crew with side loader. These models allow determination of what the time should be under any given collection situation, or application of the "what if" game, e.g., "what if" our community changes from rear loaders with three man crews to side loaders with one man crews?

In the interest of time, we will not go over each of the models here, but would be happy to discuss them in detail with any of you after this session.

Application of these models to any specific local collection situation yields the answer to the question which the vast majority of collection managers must ask if they desire to achieve a reasonable level of productivity - how much time should be required for my present mix of equipment and crew size to service a given number of stops in my specific collection situation? Without knowledge of this number, there is no valid justification for questioning the amount of time which is currently being taken to do the work. Without this true productivity analysis, only "pseudo" improvements in productivity will be made, i.e., changes in the service level or implementation of other obvious measures. True productivity improvements require an increase in measurable output, i.e., stops or tonnage collected per unit of measurable input, i.e., minutes or hours of labor.

GENERAL APPLICATION OF METHODOLOGY

Application of the methodology identifies the reasonable level of productivity which should be expected for the existing mix of men and equipment, and the collection situation, i.e., a "fair day's work." Maximum utility of the methodology is achieved by using the models to estimate expected productivity levels if alternative collection equipment and crew sizes are used in the same collection situation. Following categorization of the collection situation and identification of the optimal refuse collection vehicle for that situation, and subsequent application of local cost factors, these accurate estimates of productive time requirements allow development of total service cost comparisons between existing and alternative collection crew size/equipment combinations.

Thus, the most cost-effective residential solid waste collection system for a specific collection situation and desired service level can thereby be readily identified and documented. A "real world" example of the application of the methodology best illustrates its practical utility.

SPECIFIC APPLICATION: BRUNSWICK, MAINE

The Town of Brunswick has a population of approximately 18,000 and is located 25 miles northeast of Portland, Maine. The town provides once weekly curbside collection to all of its citizens. The town had traditionally used two rear loading packers with three man crews to provide the service. In October 1978, the town retained SCS Engineers to evaluate collection operations and make recommendations as to the collection equipment/crew size for most cost-effective service. At the onset, town officials imposed the following constraints, impacting both collection situations and the feasible alternatives which could be investigated:

- Once weekly service must be maintained
- Curbside service must be maintained
- Mechanical systems requiring standardized containers would not be acceptable
- Collection crews' workdays should not exceed 8 hours.

SCS technicians were assigned to follow each crew on each route and record all pertinent information required for application of the methodology previously described.

As a result of these field observations, it was determined that two distinct "collection situations", rural and urban, existed. The primary distinguishing characteristics of the two collection situations are illustrated in Table 3.

Analysis of the observed and recorded productivity of the two crews revealed that one was approximately 16 percent below and the other five percent above the "standard" predicted by the SCS model for three man crews using rear loading packers, thus eliminating crew speed or motivation as a significant factor in the productivity observed.

In view of the constraints imposed by the town (political characteristics) and the observed route related characteristics, two potentially more cost-effective collection equipment/crew size options were selected for subsequent comparison with the existing system:

1. Use of an auger type, rear loading packer with a walk through cab to allow "packing on the run" and a two man crew.
2. Use of a side loading packer with right hand drive and a one man crew.

Which would be the most cost-effective? Answering this question required an estimate of the productivity which could be expected from each, using observed route related parameters, analysis of qualitative collection situation considerations, and subsequent application of local cost factors.

Determining Productive Collection Time Requirements

First, the previously described models developed by SCS were applied to yield reasonable estimates of the productive time required to provide collection service at each stop.

Two Man Crew --

TABLE 3

COLLECTION SITUATION CHARACTERISTICS
TOWN OF BRUNSWICK, MAINE

Characteristic	Collection Situation Rural	 Urban
Distance between services (ft)	520	110
Quantity of refuse per service (lbs)	50	55
No. of cans per service	1.1	1.3
No. of plastic bags per service	1.9	2.3
No. of other throwaway items per stop	0.9	0.7
Distance from garage to route (mi)	2-5	2
Distance from route to disposal site (mi)	3-7	5
Topography	Flat	rolling, hilly
Total number of services	815	2089
Maneuverability constraints	Dead-end roads	Cul-de-Sacs

The model developed for a two man crew (driver assisting the collector) using a rear loading auger type compaction vehicle is:

$$P = 0.001D + 0.16N + 0.09T + 0.03S + 0.02$$

where

P = productive collection time required per stop, in minutes, including the driving time from the previous stop.

D = distance between stops in feet

N = number of refuse containers serviced at a stop

T = total number of throwaway items (including paper or plastic garbage bags) serviced at a stop

S = number of services collected at each stop

For the rural conditions identified in Brunswick where only one service is collected at each stop:

D = 520 feet

N = 1.1 refuse containers

T = 2.8 throwaway items (including paper or plastic garbage bags)

S = 1 service.

Thus the productive time per stop required for an auger type rear loader with a two man crew is:

$$p = 0.001(520) + 0.16(1.1) + 0.09(2.8) + 0.03(1) + 0.02$$
$$= 1.0 \text{ minutes per stop or service}$$

Applying the same analysis to the urban situation where 1.2 services can be collected at each stop, yields a productive time requirement of 0.6 minutes per service. Thus, the total productive on-route collection time required to collect wastes from 815 rural services and 2,089 urban services would be approximately 2,068 minutes or approximately 35 hours per week.

The next step was to identify the optimally sized refuse collection vehicle to maximize on-route time. This requires identification of the total productive on-route time available each day. The time available for collection each day equals the total workday minus non-productive collection time. Non-productive collection time includes:

- Driving time from garage to route
- Driving time to the disposal site
- Driving time from disposal site back to route or garage
- Dumping time at the disposal site
- Packing (if packing cannot take place while truck moves)
- Delays
- Breaks

Since the total non-productive collection time increases with the number of trips which the collection vehicle must make to the disposal site, ideally, a truck should be used which would require only one trip per day. In most cases the amount of refuse which a collection crew can pick up in one day exceeds the capacity of the largest collection truck available. Thus, the optimally sized vehicle is one which will be completely filled two or three times per day. Purchase of a truck with excess payload capacity results in an unnecessarily high purchase price as well as higher operation and maintenance costs, while a truck with insufficient capacity will require an excess number of trips to the disposal site.

SCS has also developed a step-by-step technique for determination of optimal vehicle payload capacity. This technique involves use of time estimates for refuse collection provided by the model, plus the average quantity of refuse collected at each stop. Application of this technique for any collection situation will reveal the optimal payload capacity for that specific case. Knowledge of the payload capacity allows subsequent calculation of the total time required for provision of residential collection service.

Application of the methodology revealed that the optimal payload capacity for the refuse collection vehicle would be 21,000 lbs and 19,500 lbs for the rural and urban collection situations respectively. These payload capacities would maximize crew on-route collection time by requiring only one load per day in the rural situation and allowing two full loads per day in the urban situation.

Refuse collection vehicles with these payload capacities would allow time to collect from approximately 420 and 710 services per day in the rural and urban collection situations respectively. Approximately 10 man-days would be required to service all 2,904 residential stops. However, in addition to this residential service, the town also collects wastes from 679 mobile home units, the community hospital and four schools. Since the town was also considering providing collection of separated recyclable materials with the same equipment, it became apparent that two trucks and two crews would be required. Therefore, one truck with a payload capacity of 21,000 lbs and one with a payload capacity of 19,500 lbs would be utilized.

One Man Crew--

The same methodology used to determine collection service time requirements for two man crews with rear loaders can be used for one man collection systems. The model which best describes the productive collection time required for the one man side loading trucks has the same predictive parameters (with the exception of S, since only one service is typically collected at each stop), but obviously with different coefficients:

$$P = 0.005D + 0.15N + 0.08T + 0.08$$

For the two collection situations previously identified in Brunswick, P, the productive collection time required per service, would be 0.58 and 0.73 minutes per urban and rural service respectively. Thus, the total productive on-route collection time required to collect wastes from 2,904 services would be 1,807 minutes, or approximately 30 hours (See Table 4).

The optimal payload capacities for the one man, side loading truck were determined to be 16,400 and 11,600 for the urban and rural areas respectively. These payload capacities would maximize the productivity of the operator, and allow him to take two full loads to the disposal site each day.

Vehicles with the above payload capacities would allow the operator to collect from 600 and 420 services per day in the urban and rural areas respectively. Approximately 5.5 days would be required to collect from all 2,904 services. Thus, a single one man crew would be required to work an average of 5.5 days to provide weekly collection service to all residents. To provide weekly collection service to the mobile home

TABLE 4

RESULTS OF PRODUCTIVITY ANALYSIS - BRUNSWICK, MAINE

Productivity Measure	Existing System 3 Man Crew RL	Alternative #1 Augur Type RL 2 Man Crew	Alternative = 2 Drop Frame SL 1 Man Crew
Collection Situation #1 - Rural			
Average time required per stop (min)	0.70	1.00	0.73
Productive time required per wk (min)	570	815	595
Productive manhours required per wk	28.5	27.2	9.9
Collection Situation #2 - Urban			
Average time required per stop	0.55	0.60	0.58
Total productive time required per wk	1149	1253	1212
Productive man-hours required per wk	57.5	41.8	20.2
Total productive man-hours required per week (rural + urban)	85.0	69.0	30.1
Total number of trucks required	2	2	2

parks, community hospital and schools would require a second truck and man. Thus, one truck with a payload capacity of 16,400 lbs., and a second with a payload capacity of 11,000 lbs. would be purchased.

Estimating Costs for Each Alternative

The next step was to calculate all costs associated with each alternative to allow comparison with existing costs and ultimate identification of the most cost-effective system.

Two Man Crew --

It was determined that two-20 cubic yard high compaction, auger type packers would meet the payload requirements desired for the two man crew alternative. The cost of each would be approximately $50,000, or $100,000 for both units.

Annual operating costs consist of expenses for personnel, equipment, amortization, fuel, maintenance and miscellaneous supplies. The costs associated with each were calculated, taking into account specific local cost factors and have been summarized in Table 5. The total annual cost was estimated to be $86,211 for this alternative.

One Man Crew --

From the previous analyses, it was determined that one man, side loading trucks with 16,400 and 11,600 lb. payload capacities would be optimal for the urban and rural collection situations, respectively, in Brunswick. One 25 and one 21 cubic yard side loading truck would be needed. The cost of these vehicles would be approximately $70,000 and $66,000, respectively. Thus, the total capital investment required by the town would be approximately $136,000. The total annual costs associated with this alternative

TABLE 5

ESTIMATED ANNUAL COST OF MUNICIPAL WASTE AND SOURCE SEPARATED COLLECTION SERVICE - TOWN OF BRUNSWICK PUBLIC WORKS DEPARTMENT

Cost Category	Cost Associated with Alternative		
	3 Man Crews with Rear Loading Packers (2 crews)	2 Man Crews with Rear Loading Packers (auger type) (2 crews)	1 Man Crews with Side Loading Packers (2 crews)
PERSONAL SERVICES			
Salaries and Fringe Benefits Permanent Employees	$ 69,888	$ 47,424	$ 26,208
Vacation and Sick Leave Replacement	5,591	3,794	1,897
EQUIPMENT			
Amortization	15,355	18,193	25,272
Maintenance	7,200	7,200	7,200
Fuel	6,000	6,000	8,400
Insurance	2,000	2,400	3,000
Outside Rental	600	600	600
MATERIALS AND SUPPLIES			
Miscellaneous Supplies	600	600	600
SUM OF ANNUAL COSTS	$107,234	$ 86,211	$ 73,177

were estimated to be $73,177. A breakdown of the annual cost is shown in Table 5.

Results of Productivity Analysis

The analyses revealed that use of side loading packers with one man crews would cost approximately 30 percent less than use of conventional rear loading packers with three man crews. The comparison of crew time allocation between productive and non-productive activities for three and one man crews effectively illustrates why this is so (Table 6). A high percentage of non-productive time is inherent in three man crews; 68.4 percent vs. only 14.4 percent for the one man crew for the specific conditions in Brunswick.

Based on the results of this comprehensive analysis and other considerations also identified by SCS, the town purchased two one man refuse collection vehicles. These two vehicles were placed in service in March 1980, and have achieved the productivity rates predicted by the models. Thus, it is anticipated that the town will indeed achieve the 30 percent reduction in service costs as also predicted.

SUMMARY

Models exist which can accurately estimate time required to provide collection service for various crew size/equipment combinations given the distance between stops, and the number of each type of container at each. The ability of these models to produce accurate estimates of productive collection requirements has a wide range of practical applicability. The models can be an invaluable management tool when applied in the following situations:

TABLE 6. PRODUCTIVITY COMPARISON OF WEEKLY MUNICIPAL COLLECTION CREW TIME - ONE-MAN VS. THREE MAN CREWS

Activity	Man - Minutes Per Week Allocated To Each Activity									
	Man - Minutes Per Week Spent by Each Member of 3 Man Crews (2)									
	Driver		Collector #1		Collector #2		Total Crew		One - Man Truck Crews (2)	
	Productive Time	Non-Productive Time	Productive Time	Non-Productive Time	Productive Time	Non-Productive Time	Productive Time	Non-Productive Time	Productive Time	Non-Productive Time
1. Driving Garage to Route	36			36		36	36	72	37	-
2. Collecting Waste at Stops		1,474	1,105	369	1,105	369	2,210	2,212	1,783	
3. Driving Between Stops	326			326		326	326	652	464	
4. Driving from Route to Disposal Site and Return to Route or Garage	293			293		293	293	586	375	
5. Time at Disposal Site	68			68		68	68	136	80	
6. Waiting for Completion of Compaction Cycle		221		221		221		663	-	
7. Delays		93		93		93		279		140
8. Breaks		585		585		585		1,755		320
TOTALS	723	2,373	1,105	1,991	1,105	1,991	2,933	6,355	2,739	460
PERCENT OF TOTAL WORKWEEK	23.3	76.7	35.7	64.3	35.7	64.3	31.6	68.4	85.6	14.4

1. Preparation of bids by private contractors.
2. Evaluation of an existing residential collection system allowing comparison with a reasonable standard or "fair day's work".
3. Evaluation of the effect of changing crew size.
4. Evaluation of the impact of increasing or decreasing the quantity of refuse per stop.
5. Evaluation of the impact of utilizing a different type of collection equipment.
6. Evaluation of the impact of changing collection frequency.
7. Evaluation of the impact on total system cost of changing the collection point, i.e., from backyard to curbside.
8. Evaluation of the impact of changes in the type and/or number of containers to be picked up, i.e., cans vs. plastic or paper bags.
9. When desiring to balance work loads between crews.

It is important to emphasize that a comprehensive evaluation of any residential waste collection system for the purpose of improving productivity and/or reducing costs entails consideration of unique peculiarities far too numerous to list and discuss in this presentation. For purposes of brevity, the actual application of the methodology proposed to accomplish that objective has been simplified, and thus, many of the relevant factors which also bear on the ultimate cost-effectiveness have been disregarded. For example, a comprehensive collection system evaluation should also include identification of optimal refuse collection vehicle performance specifications and life cycle costing. However, these warrant presentations all by themselves.

The productive collection time models provide an effective tool for identifying the reasonable productive collection time required per stop taking into account the most important route related collection characteristics. It is necessary for meaningful comparisons between existing productivity and that which could be achieved using different collection equipment/crew size combinations. The methodology also provides managers with an additional tool to use in considering the ramifications of changing one or more of the specific characteristics of the local collection situation. By itself, the productive collection time determination process is not the panacea for optimal waste collection operations. Efficient management of personnel, good operating policies and procedures, and effective communications with the general public are all necessary ingredients. However, in light of skyrocketing energy costs and the motivation of today's taxpayer to minimize his tax burden, solid waste managers can ill-afford to ignore any tools which result in more cost-effective residential collection service.

TRANSTOR WASTE TRANSFER SYSTEM

THE ALBERTA EXPERIENCE

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In the February, 1981 issue of CIVIC Magazine there appeared an article written by myself titled Rural Alberta's Unique Waste Transfer System. I think it is fair to say the tone of the article could be described as "upbeat" even though there were indications at the time that some "people problems" were beginning to surface.

Later on you will see that the "people problems" became significant but certainly not as substantial as the local politicians would have us believe. Nevertheless, there was an overreaction by the politicians to the extent that representatives from many of the communities using the transfer system made requests to have the transfer stations removed or threatened to withdraw from the incorporated agency that was the operating body for the system.

Before we can place the problems in perspective though, it is essential first to describe the system.

The central feature of the system is a 46 cubic yard, stationary, storage bin called TRANSTOR that is capable of being inverted so that its contents can be dumped into an open-top, 110 cubic yard trailer. The idea was based on the wide-spread use of silage dumpers that farmers use to collect freshly cut silage from a field and then dump into trucks travelling beside the unit. The TRANSTOR is an Alberta product. It is manufactured by Neufeldt Industries of Lethbridge, whose one man Haul-All trucks are known nation-wide.

Each Transtor is mounted above ground level on steel supports anchored to a concrete foundation. Access to the container is provided by an elevated, earthen ramp supported at the container end by a corrugated bin wall (earlier models used a concrete retaining wall).

A small pull-out chute on the front of the container permits entry of individual bags of garbage. To admit larger quantities of waste from personal vehicles or conventional packer trucks, the container is fitted with a two-piece lid that folds open like an accordion by means of electro-hydraulics.

When the container is full, an hydraulic system having a 15 ton lifting capacity raises the container and inverts it over the open-top trailer. The hydraulic system is operated directly from the tractor that pulls the trailer. To prevent littering of highways, the trailer is equipped with litter screens that swing over the top once the trailer is loaded.

The so-called "live-bottom" trailer is equipped with several sets of floor chains that convey waste out the back of the trailer upon arrival at the landfill. The trailers are manufactured in the western U.S. with distributorships in Alberta.

A network of TRANSTORS began operation two years ago throughout a 5100 square mile area surrounding the City of Drumheller. At present there are 18 TRANSTOR containers placed near 15 communities (one community uses two containers; another one uses three). It is 60 miles from the landfill at Drumheller to the farthest distant community. Travel distances to most other communities average close to 30 miles. The area is serviced by two trailers that travel a total of 1600 miles a week or about 6800 miles each month. This allows every TRANSTOR to be emptied at least twice a week and some are dumped once a day.

The overall system--transfer stations, haulage service and landfill--is operated by the Drumheller and District Solid Waste Management Associatio It is comprised of political representatives from one county, two municipal districts and about 12 communities. During the formation of the Association a decision was made - to be regretted later - that each political body was responsible for the maintenance of containers within its jurisdiction. Any associated costs would be borne by the individual bodies and not collectively by the Association.

Capital funding for the system was provided by Alberta Environment through its Solid Waste Management Assistance Program. To date, well over $1 million has been spent on purchasing land for transfer station sites and equipping both the transfer system and the sanitary landfill. Capital costs per transfer station (table attached) average out at about $46,000 including variable costs of land purchase and provision of electric power.

The four acre transfer station sites are fenced with page wire and provided with signs, culverts, landscaping and dusk-to-dawn lighting. Some are open specified hours; others can be opened by obtaining a key from a village office. The remainder are left open all the time. Only one of the sites is provided with an attendant.

The Association's 1981 operating budget of approximately $200,000 translates into $12 per ton to haul and landfill rural wastes. But, in recent months a significant additional cost has arisen - the cost to repair damaged TRANSTORS, in particular at three of the fifteen sites.

These "people problems" are of four types:

1. Fires - some are believed to have been set intentionally; others by dumping hot ashes into the TRANSTORS.
2. Vandalism - has included severed power cables; theft of electrical switches or destruction of them; broken lights and theft of wooden or concrete stop logs.
3. Overloading - containers have been filled with concrete pieces, gravel, dirt and sod, asphalt roofing material and other demolition material. In every case, the hydraulic cylinders were unable to lift the container. In some instances metal side panels were knocked out when the materials were dumped into the containers.
4. Mechanical failures - sometimes the lid has failed to open because someone backed into it, causing it to buckle. Other times, lids have become warped when fires occured inside the container.

Over the past 18 months repair costs have amounted to at least $30,000 and, at the time of writing, additional repairs were required at several of the stations.

Because individual communities are responsible for repair costs, some have been slower than others to take corrective action. This has resulted in some stations remaining inoperative for several days or longer, causing garbage to accumulate on the ground and ramp surrounding the TRANSTOR. The trucker (a private contractor) made a valiant attempt for awhile to make some repairs himself but this resulted in his failing to adhere to a fixed pickup schedule. As a consequence he became the target of criticism to which he responded by allowing the level of his service to decline.

By this past April individual members of the Association were threatening to withdraw their membership and the more macho ones were even talking of dismantling the transfer stations and hauling them to their former dump sites!

Alberta Environment, fearing total collapse of the system, stepped in with an offer to pay the salary of a manager for one year. It seemed apparent that a lack of system management and control of public access were the major causes of the difficulties. Therefore, the manager's tasks include the provision of direction, immediate response to problems and the implementation of procedures to bring the system to its full operational potential. After the one-year demonstration period, Alberta Environment expects the Association to continue management according to the program developed by the manager.

One final word on this situation - the Association and Alberta Environment co-operated in the production of an information brochure that was delivered to every home in the service area. But it was delivered several weeks after the system became operational. The delay occured when both parties were unaware that a draft copy of the brochure mailed by one party to the other had not been delivered by our ever faithful posties. Quite probably some of the incidents of accidental abuse could have been avoided had users of the system been informed beforehand.

By way of contrast with the Drumheller experience, the same system of TRANSTORS and trailers (employing the same trucker) is being used in Banff National Park and Kananaskis Country, the latter being a large provincial park adjacent to Banff. Waste is hauled out of the parks to Calgary's Spy Hill Landfill. The return haul distance from Banff is about 256 miles. The problems encountered in the Drumheller area have been absent from Banff and Kananaskis because both parks introduced a fair measure of control on the transfer sites and both were able to take advantage of existing public works and maintenance facilities when repairs were required.

Within Banff National Park, TRANSTORS are found at Banff townsite (four containers) and Lake Louise (three containers). In both instances the transfer containers are surrounded by steel walls to prevent entry by bears. Waste delivered to the stations is collected from the townsites and campgrounds in Parks packer trucks and, therefore, Parks employees are the most frequent users of the stations. The sites are open to the public during specified hours but it is estimated that 10% or less of the waste is delivered by individual residents or merchants.

Within Kananaskis Country, there are three transfer sites, each using only one TRANSTOR. Access is restricted to those persons having a key to the gate which means Parks employees only. Public works employees of both parks are enthusiastic about the TRANSTOR system as a satisfactory means of garbage storage and haulage and also as a deterrant to visitations by the furry residents of the parks.

Because service within Kananaskis began only a few months ago, reliable operating costs cannot be reported. However, the system within Banff has been operational for nearly a year and is generating meaningful cost figures. The combined waste generation from both stations is predicted to be 7000 tons this year. The cost of haulage is about $20 per ton (it varies from summer to winter) and landfilling fees amount to about $4 per ton.

What has been learned from the operating experience to date? First of all, a transfer station must be managed and controlled just as a landfill must be if either is to be something other than an open dump. The latter operation is the one most local politicians have known all their lives and it comes as quite a shock to learn that neglect no longer is acceptable. It also appears that the TRANSTOR itself is sound mechanically even though, like most machines, it has its limitations. When the waste is "soft" (i.e. the household variety) few problems should be anticipated from overloading or structural damage. But rural wastes include everything. Without controls, education and some changes in users' habits it is suspected that neither TRANSTOR nor the conventional roll-off system could function for long in an unscathed condition in a rural setting. However, that suggests that TRANSTOR is at least the equal of a roll-off system.

TYPICAL TRANSFER STATION COSTS

TRANSTOR	$16,200
EARTH WORK, CONCRETE, BIN WALL, GRAVEL	$10,200
FENCING, GATES, SIGNS	$ 5,200
LANDSCAPING	$ 2,400
CULVERTS	$ 1,400
TOTAL	$35,400

PLUS VARIABLE COSTS TO PURCHASE 4 ACRES OF LAND AND PROVIDE POWER.

TRAILER COST -- $50,000

SUMMARY OF KNOWN INCIDENTS

LOCATION	FIRES	VANDALISM	OVERLOAD	MECHANICAL FAILURE
* CARBON	--	--	--	--
* ACME	1	2	1	--
* THREE HILLS	2	1	3	8
* MUNSON (NEW)	--	--	--	--
* LINDEN (NEW)	--	--	--	--
* GLEICHEN (NEW)	--	--	--	--
ROCKYFORD	--	--	1	1
STANDARD	1	--	--	--
ROSEBUD	1	--	--	--
BEISEKER	--	1	--	--
EAST COULEE	--	--	--	--
HUSSAR	1	--	1	1
CLUNY	--	--	--	--
CARSELAND	2	1	3	3
STRATHMORE	5	11	7	9

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* CONTROLLED SITES

BANFF NATIONAL PARK

WASTE GENERATION	APPROX. 7,000 TONS/YR.
COST - HAULAGE	$20/TON
- TIPPING	$ 4/TON
TRAILER LOAD LIMIT	38,000 LBS.
AVERAGE RETURN DISTANCE, BANFF PARK - CALGARY	256 MILES (410 KM)

9/25/81

WASTE MANAGEMENT, INC.

Presented by Richard R. Crites

FULL CONTRACT SERVICE

In February 1977, Waste Management-Saudi Pritchard signed a five-year, 243-million dollar contract with the Kingdom of Saudi Arabia's Ministry of Municipal and Rural Affairs to provide refuse collection, street cleaning, catchbasin cleaning, abandoned auto removal, and sanitary landfill services to that nation's capital city of Riyadh.

At that time the service and facilities contract was the largest and most comprehensive of its type ever awarded in international bidding. It called for complete mobilization in less than one year's time--including construction of a 32-acre public cleansing center to maintain the massive imported fleet and to house a 2,500-man multi-national workforce;

purchase and overseas delivery of 450 pieces of solid waste collection, street cleaning and sanitary landfill equipment; and the recruiting, training and transportation to Riyadh of administrative, supervisory and labor personnel.

In effect, the Waste Management-Saudi Pritchard joint venture--in which we are a majority partner--was called upon to establish, equip and staff a total public works department to serve a rapidly growing city of more than three quarters of a million residents.

Finally, the contract specified that we establish and maintain an ongoing public information program introducing the city's population to the new public cleansing system and equipment, and encouraging citizen support and understanding.

Two and one-half years later, another joint venture in which Waste Management International is a majority partner was awarded a 10-year contract--then valued at approximately 400-million dollars--to provide similar services to a 68-square mile section of the federal district of Buenos Aires, the world's fifth largest city. This contract called for daily collection of residential wastes from more than 600,000 households, sweeping and flushing of major streets and thoroughfares, and regular cleansing of 15,000 storm sewer catchbasins. Again, it encompassed complete mobilization--within 144 days--of all manpower and equipment necessary to perform the contracted services.

Within the past three months our company and separate venture partners have received similar contracts, through international bidding, for a major portion of the

City of Caracas, Venezuela; the City of Cordoba, Argentina, and the Saudi Arabian port city of Jeddah. Each is a full service contract, incorporating street cleaning, refuse collection and related services.

Other major cities of the world are even now preparing international calls for proposals for public cleansing systems patterned after these already successful efforts.

The opportunity and challenge are almost unlimited--both for the public agencies contemplating such major cooperative efforts with private sector public cleansing contractors, and for the contractors themselves.

Using our Buenos Aires experience as an example, I'd like to share with you some of the basic elements, costs, and methods employed by both public and private sector participants in advertising and bidding contracts of this magnitude.

In doing this, we can perhaps discover whether a realistic opportunity exists for similar full service contracts here in North America.

As I noted earlier, Buenos Aires is the world's fifth largest city. It is the heart of a spreading metropolitan area of almost nine million people. The city is much more like a North American or European city than many of us might imagine.

Buenos Aires is the capital of a major industrial nation seeking increased participation in international commerce and industry. Argentina is a relatively young nation, founded in 1816. Its population swelled rapidly during the late nineteenth and early twentieth centuries by tens of thousands of Italian, French, English, German, Polish, and of course, Spanish immigrants.

The city, therefore, has a strong European influence, with a blending of ethnic neighborhoods very much like many of our major North American urban centers.

It is a city that has undergone rapid industrial growth. A mixture of densely populated, highrise apartment complexes, heavy vehicular traffic, and light and heavy industrial development has created many of the same environmental problems that plague North America's major industrialized urban centers.

Unlike its North American counterparts, however, Argentina has experienced skyrocketing inflation and the resultant political unrest during much of the twentieth century. The country's political, social and economic leaders have, therefore, taken great pains to improve the quality of urban life. As home to nearly 26 per cent of the nation's populace and much of its heavy industry, Buenos Aires was selected as the first target for improving the urban environment.

CEAMSE, the public agency with which we signed our public cleansing contract in 1979, was formed in 1977 by the Municipality of Buenos Aires and the Province of Buenos Aires to implement a program of environmental recovery for the greater Buenos Aires area.

Its primary function was to establish an ecological green belt, using sanitary landfill to reclaim lowlands and develop public parks, forests and recreational areas with easy access to the area's nine million residents. CEAMSE planners calculated that savings from improved street cleaning and solid waste collection, transfer and disposal practices would finance the long range environmental improvements envisioned in CEAMSE's charter.

A transfer/sanitary landfill contract was awarded in late 1978, and preparations immediately began for an international call for bids on refuse collection and street cleaning services.

Much of our success in responding to this international call for proposals can be traced to the thoroughness of CEAMSE's planning, and to the cooperation provided by the agency and its consultants during the vital pre-bid survey and subsequent mobilization.

CEAMSE, for example, protected itself from the prospects of a poorly qualified low bidder--one that had neither the operating experience nor the financial capabilities to adequately perform the specified services--by a unique "two envelope" bid procedure.

All respondents were required to submit a detailed plan or operations--including a list of manpower and equipment, plus a detailed mobilization timetable and operating plan--in a sealed envelope, along with proof of financial and technical capabilities.

Price proposals were submitted in a second sealed envelope, which would be opened only if the bidding firm had proven itself financially and operationally qualified.

Of the seven firms submitting proposals, three were adjudged qualified. The sealed price proposals of these three qualified bidders were opened, and the Manliba joint venture--60 per cent owned by Waste Management International and 40 per cent owned by Impresit Sideco, an Argentine engineering and construction firm--was low bidder.

Equal care must be taken by any firm bidding a contract of this magnitude. Waste Management and its partners expended over 1,300 mandays in Argentina prior to submitting our successful proposal.

Operating specialists surveyed city streets and thoroughfares. They reviewed parking ordinances and practices, and studied existing streetsweeping equipment and methods. Other teams carefully measured solid waste generation by neighborhood, street, and individual residence--actually weighing and measuring representative household samples. They rode trucks with existing collection crews, and studied their productivity to discover the best combination of manpower, equipment and routing to provide improved and more efficient service.

Legal and financial teams thoroughly reviewed international currency exchange rates, and the effects of Argentina's high rate of inflation upon the eventual pricing of the services and facilities specified in the request for proposals. They reviewed local labor laws and productivity standards. They studied banking practice, import duties, and laws governing Argentine business and financial practice.

Working together, these teams then reviewed locally available equipment, and compared its performance with similar equipment of North American and European manufacture.

Maintenance costs, and the probable expense of establishing parts and maintenance inventories were carefully charted, and then matched with the operating plans prepared by our streetcleaning and waste collection experts.

Meanwhile, stateside personnel carefully researched manufacture and delivery lead times for refuse bodies and containers, while our London office researched manufacture and delivery of streetsweepers and other items of European manufacture.

Shipment costs, ports of debarkation and embarkation, shipping times, rates and schedules were calculated and calendarized to meet the 144-day mobilization timetable.

Naturally, our earlier experiences with the Riyadh mobilization and startup proved invaluable. Nonetheless, the fact that CEAMSE was able to complete the entire process--from advertisement for proposals to start of service--in only 45 weeks speaks well of the thoroughness of their own planning and mobilization monitoring.

We believe that CEAMSE and the people of Buenos Aires are happy with the results that have been realized. In fact, in the first CEAMSE annual report published after we started service, the agency reported that it had both improved the level of service provided the city's residents and lowered the cost of these services by a full fifty per cent.

I am equally certain that both Riyadh and Buenos Aires are cleaner, healthier and more attractive cities today than they were when our joint ventures began serving them.

If cities in the Middle East and South America can realize improved service at a lower total cost through full service public cleansing contracts, it is only natural to wonder whether North American communities could enjoy similar results.

To begin with, the emergence during the past decade of major national and multinational service companies such as Waste Management--companies totally dedicated to solid waste and municipal cleaning services--provides the North American public works director with a new source of financially and operationally qualified service firms.

Possibly on the basis of our own successful experiences in Riyadh and Buenos Aires, the three major U. S. solid waste firms have recently begun active pursuit of contract streetsweeping services within the North American marketplace.

We have expanded our service horizons, and we have gained valuable operations and maintenance experience in streetsweeping, streetflushing, storm sewer cleaning and related services.

We have established productivity standards and utilization schedules for these highly specialized machines. We believe that combining these units with existing solid waste collection fleets at selected North American locations can provide marked efficiencies for the municipal customer.

Literally thousands of smaller North American municipalities, for example, own and maintain mechanical streetsweepers that are operated at less than full capacity. Their activities are restricted by municipal boundaries which restrict service to otherwise contiguous neighborhoods.

A contracted sweeping service could increase productivity by serving neighboring communities or by serving a mixture of municipal and commercial customers within the municipality itself.

Experienced maintenance personnel, parts inventories and preventive maintenance procedures could be centralized for increased efficiency. Backup and reserve equipment, likewise, could be shifted from one community or operating division to another on an "as needed" basis, rather than sitting idle in a municipal garage.

Even in major cities, a contracted service could realize economics in equipment utilization unavailable to the municipality by expanding streetsweeping activities into bordering collar communities.

Similar economies can be anticipated for vacuum pumpers, flushers and other highly specialized equipment necessary to a clean and healthy urban environment--equipment that functions substantially below capacity in service areas restricted solely by political boundaries.

Private companies, such as Waste Management, have demonstrated the ability to provide contracted or franchised solid waste collection services to more than 180 political entities in the United States and Canada--coupled with our nearly five years of street cleaning and related services overseas--uniquely qualifies Waste Management as a single-source, full service contractor here at home.

Changing economic and political climates, both in the United States and Canada, are putting increased budget pressures on municipalities of every size. Consequently, if we can indeed offer improved service at lower total cost, I feel that both municipal government and the major full service contractors, such as ourselves, would be negligent if they failed to thoroughly investigate the mutual benefits of full service municipal cleaning contracts.

October 15th - 8:45 - 10:15 a.m.

Politics of Siting

Moderator:	Boris Boyko Ontario Ministry of Environment Toronto, Ontario
Panelists:	Jim Temple Waste Management of Canada Weston, Ontario (Maple LF site)
	Tom Fowle Simcoe Engineering Ltd. Pickering, Ontario (Ajax treatment plant)
	Mayor Francene Cosman Town of Bedford, Nova Scotia (siting opposition)

PAPER PREPARED FOR
THE THIRD NATIONAL CONFERENCE
ON WASTE MANAGEMENT

BY

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PRESIDENT
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THIRD NATIONAL CONFERENCE ON WASTE MANAGEMENT

INTRODUCTION

THE AJAX PROPOSAL WAS TO CONVERT A REDUNDANT 3 MGD MUNICIPAL SEWAGE TREATMENT PLANT INTO A 25,000 G.P.D. LIQUID INDUSTRIAL WASTE TREATMENT FACILITY. THE ORIGINAL PLANT WAS MADE REDUNDANT BECAUSE OF THE DEVELOPMENT OF A NEW AND LARGE CENTRALIZED SEWERAGE SYSTEM. FOR 25 YEARS THE SITE HAD BEEN OCCUPIED BY THE SEWAGE TREATMENT PLANT IN ITS VARIOUS STAGES OF DEVELOPMENT.

AS AN INDUSTRIAL WASTE TREATMENT FACILITY, EXPANSIONS AND MODIFICATIONS WOULD HAVE BEEN CARRIED OUT WHICH IN SUMMARY WOULD HAVE COMPRISED:

(1) A LABORATORY/ADMINISTRATION CENTRE

(2) A WASTE RECEIVING AREA

(3) THE ADDITION OF SAND AND CARBON FILTERS AND SLUDGE CONDITIONING EQUIPMENT

(4) MODIFICATIONS TO EXISTING TANKS TO PROVIDE SPECIALIZED LININGS AND COVERS, ETC.

ON THE FOLLOWING SLIDE THE INDUSTRIAL WASTE PLANT AS PROPOSED IS SHOWN.

IT WAS PROPOSED THAT FOUR TYPES OF WASTES WOULD HAVE BEEN RECEIVED NAMELY, SPENT ACIDS, ALKALIES, OXIDIZING WASTES, OIL/WATER MIXTURES AND CYANIDE WASTES. EXTENSIVE MEASURES WERE PROPOSED TO CONTROL THE ACCEPTANCE OF WASTES AND THE QUALITY OF THE EFFLUENT THAT WOULD BE DISCHARGED TO THE MUNICIPAL SEWERAGE SYSTEM.

APPROVALS

FOR A FACILITY OF THIS KIND, THE MOST IMPORTANT APPROVALS NORMALLY REQUIRED WOULD FALL INTO THREE CATEGORIES, NAMELY:

(1) PLANNING
(2) ENVIRONMENTAL
(3) OPERATING SAFETY

PLANNING

IN THE PLANNING BY-LAW FOR THE TOWN OF AJAX THE SITE WAS ZONED FOR THE EXCLUSIVE USE OF A PUBLICALLY-OWNED SEWAGE OR WATER TREATMENT PLANT. AS PROPONENTS, THE REGIONAL MUNICIPALITY HAD NO REASON TO OBTAIN APPROVAL UNDER ANY PLANNING REGULATIONS SINCE THIS ASPECT OF THE PROPOSAL WAS ALREADY SATISFIED. ON THE NEXT SLIDE IS SHOWN THE AREA IN AJAX WHERE THE PLANT WAS TO HAVE BEEN LOCATED AND THE ADJACENT AREA OF THE TOWN OF PICKERING. THE LAND ZONED FOR INDUSTRIAL USES IS SHOWN, AND THE PROPOSED PLANT IS WELL INSIDE THIS AREA.

ENVIRONMENTAL APPROVALS

IN THIS REGARD THERE ARE TWO PROVINCIAL STATUTES WHICH APPLY, NAMELY, THE ENVIRONMENTAL PROTECTION ACT AND THE ONTARIO WATER RESOURCES ACT. FOR THE AJAX PROJECT THERE WAS A CERTAIN AMOUNT OF OVERLAP IN THE PROVISIONS OF THESE ACTS. THE ENVIRONMENTAL PROTECTION ACT PROVISIONS WERE MORE EXTENSIVE AND BY SATISFYING THESE ISSUES THOSE PRESCRIBED UNDER THE O.W.R. ACT WOULD ALSO BE SATISFIED. THE REGION MADE APPLICATION TO THE MINISTRY OF THE ENVIRONMENT WHO REQUESTED THE ENVIRONMENTAL ASSESSMENT BOARD

TO HOLD A PUBLIC HEARING, AS REQUIRED UNDER THE ENVIRONMENTAL PROTECTION ACT.

AS PART OF ITS APPLICATION, THE REGION PREPARED FIVE VOLUMES OF BOUND DOCUMENTS, TWO SCALE MODELS AND VARIOUS OTHER EXHIBITS WHICH WERE SUBMITTED WITH THE EVIDENCE PRESENTED AT THE PUBLIC HEARING.

PUBLIC HEARING

THE HEARING STARTED IN MID DECEMBER 1979 AND ENDED IN MID JUNE 1980. THE BOARD SAT FOR A TOTAL OF 38 DAYS, OF WHICH 3 WERE OCCUPIED BY PRELIMINARIES, 25 BY THE PRESENTATION OF THE PROPONENT'S CASE, 3 BY EVIDENCE FROM THE MINISTRY OF THE ENVIRONMENT, 5 BY THE PRESENTATION OF EVIDENCE BY THE TOWN OF TOWN OF AJAX AND BY OPPONENTS, AND 2 FOR FINAL ARGUMENTS.

OTHER APPROVALS

THE OTHER APPROVAL PROCEDURES REFERRED TO WOULD FOLLOW ONLY AFTER THE FINAL DETAILED DESIGN AND CONSTRUCTION OF THE FACILITY.

LEVELS OF GOVERNMENT

FOR THE FEASIBILITY STUDY, TWO LEVELS OF GOVERNMENT WERE PRINCIPALLY INVOLVED, SUPPLY AND SERVICES CANADA AND ENVIRONMENT CANADA REPRESENTING THE FEDERAL GOVERNMENT, AND THE REGIONAL MUNICIPALITY OF DURHAM AS OWNERS OF THE FACILITY.

FOR THE NEXT STAGE OF THE DEVELOPMENT OF THE PROJECT, TWO LEVELS OF GOVERNMENT WERE ALSO PRINCIPALLY INVOLVED, AGAIN THE REGIONAL MUNICIPALITY OF DURHAM AS OWNERS OF THE SITE AND PROPONENTS FOR THE FACILITY, AND THE PROVINCIAL GOVERNMENT REPRESENTED BY THE MINISTRY OF THE ENVIRONMENT, WHO WERE RESPONSIBLE FOR ADMINISTRATION OF THE LEGISLATION WHICH APPLIED.

SIMCOE ENGINEERING LIMITED, AS CONSULTANTS FOR THE DESIGN AND DEVELOPMENT OF THE PROJECT, WERE REQUIRED TO OBTAIN ALL OF THE NECESSARY APPROVALS.

WHAT HAPPENED TO THE PROPOSAL

SOME OF THE HIGHLIGHTS OF WHAT HAPPENED ARE AS FOLLOWS:

AT AN EMOTIONAL FUND-RAISING MEETING THE LAWYER FOR THE CITIZENS' GROUP OPPOSING THE PROJECT MADE A NUMBER OF ASSERTIONS INCLUDING THE FOLLOWING:

> "THEY ARE GOING TO MIX CHEMICALS TOGETHER AND SPEW THEM INTO THE AIR AND WATER - YOUR DRINKING WATER. THEY'LL TRANSFER THE WASTE FROM WHERE IT IS GENERATED TO YOUR BODIES."

THE FOLLOWING QUOTATION IS TAKEN FROM A LETTER PUBLISHED IN A LOCAL NEWSPAPER WHILE THE HEARING WAS IN PROGRESS.

> "I COULDN'T CARE LESS IF THE UPCOMING REPORT DETAILS THIS PLANT AS THE ANSWER TO AJAX'S FINANCIAL DREAMS - REPORTS CAN BE SLANTED TO SAY ANYTHING THEY LIKE BY ERRORS OF OMMISSION. I DON'T CARE IF IT SAYS THE PLANT WILL MAKE LAKE ONTARIO PURE AGAIN, WILL BE A BOON TO OUR LOCAL ECONOMY AND EMPLOYMENT, OR WHATEVER THE PROPONENTS WANT US TO BELIEVE. EVERYONE I KNOW IN AJAX DOES NOT WANT THE PLANT HERE PERIOD. AND IF MAYOR CLARK MASON DOESN'T REALIZE THIS, HE SHOULD FORGET ABOUT RE-ELECTION."

SHORTLY AFTER THE HEARING, AJAX COUNCIL PASSED A RESOLUTION OPPOSING THE PROJECT.

IN EARLY NOVEMBER 1980, THERE WERE MUNICIPAL ELECTIONS IN ONTARIO. WITH THE EXCEPTION OF ONE CANDIDATE, ALL OF THOSE SEEKING OFFICE IN AJAX CAMPAIGNED IN OPPOSITION TO THE PROJECT.

IN THEIR REPORT OF NOVEMBER 1980, THE ENVIRONMENTAL ASSESSMENT BOARD RECOMMENDED THAT THE PROJECT BE APPROVED SUBJECT TO CERTAIN CONDITIONS. WITH THE EXCEPTION OF TWO OF THESE CONDITIONS, THEY WERE ALL PART OF THE ORIGINAL PROPOSAL.

IN DECEMBER, THE TWO REGIONAL REPRESENTATIVES FROM AJAX BROUGHT A MOTION BEFORE REGIONAL COUNCIL FOR THE REGION TO WITHDRAW ITS APPLICATION FROM THE MINISTRY OF THE ENVIRONMENT FOR APPROVAL OF THE PROJECT. THIS MOTION WAS ADOPTED AND, ACCORDINGLY, THE PROJECT HAS PROCEEDED NO FURTHER.

CHANGES TO APPROVAL PROCESSES

IT IS DIFFICULT TO ADDRESS THIS ISSUE BRIEFLY AND I WILL CONFINE MY COMMENTS TO THE PUBLIC HEARING PROCESS. IN THIS REGARD, THE FOLLOWING CHANGES ARE SUGGESTED:

(1) CLEAR DIRECTION AS TO THE EXTENT TO WHICH A PROPONENT IS EXPECTED TO DEVELOP HIS PROPOSAL. IN OUR CASE WE HAD PREPARED A DETAILED CONCEPTUAL SUBMISSION WHICH WAS MORE EXTENSIVE THAN ANY WHICH HAD PRECEDED OURS. OUR OPPONENTS CONSISTENTLY ARGUED THAT THERE WAS INSUFFICIENT DETAIL IN THE PROPOSAL. NOTWITHSTANDING MANY REQUESTS FOR CLARIFICATION FROM THE BOARD, THIS ISSUE WAS NEVER SETTLED.

(2) BECAUSE THE MAJOR PARTICIPANTS AT HEARINGS ARE REPRESENTED BY BARRISTERS, THESE HEARINGS HAVE BECOME COURTROOM BATTLES. THIS HAS INTRODUCED THE ADVERSARY SYSTEM, WHERE THERE ARE WINNERS AND LOSERS, INTO A PROCESS ORIGINALLY ESTABLISHED TO ENCOURAGE THE "MAN IN THE STREET" TO PARTICIPATE IN A RELATIVELY INFORMAL PROCEDURE. BUT THE DISCIPLINE OF A COURTROOM IS NOT APPLIED. AGAIN, CLARIFICATION IS NEEDED. THE PROCESS SHOULD EITHER BE MADE LESS FORMAL OR MORE FORMAL, AND THE RULES SHOULD BE MADE CLEAR TO ALL THE PARTICIPANTS AT THE OUTSET AND THEN THESE RULES SHOULD BE STRICTLY OBSERVED.

(3) BECAUSE OF THE HIGHLY TECHNICAL NATURE OF THE ISSUES, THE HEARING BOARD SHOULD COMPRISE MEMBERS WHO ARE TECHNICALLY QUALIFIED. SINCE BOARDS ARE JUDGING HIGHLY TECHNICAL

ISSUES, PREPARED AT GREAT EXPENSE, THE PARTICIPANTS HAVE A RIGHT TO BE HEARD BY APPROPRIATELY TRAINED PEOPLE. IN THIS REGARD, THE COMPOSITION OF THE BOARD OF INQUIRY FOR THE CAYUGA PROJECT IS INTERESTING. IT COMPRISES AN ENGINEER AS CHAIRMAN, A PHYSICIAN AND A LAWYER.

WHAT WILL WE DO NEXT TIME

THIS IS A QUESTION THAT THOSE OF US INVOLVED HAVE DISCUSSED ON A NUMBER OF OCCASIONS. FROM A TECHNICAL POINT OF VIEW THERE IS VERY LITTLE, IF ANYTHING, THAT WE WOULD DO DIFFERENTLY. THE ONLY ISSUE THAT COMES TO MIND SPECIFICALLY IS CLARIFICATION ON PREPARATION OF THE PROPONENT'S CASE. WE WOULD SEEK CLEAR DIRECTION IN THIS RESPECT TO ENSURE THAT THE BOARD'S REQUIREMENTS ARE MADE KNOWN AND ARE FULLY COVERED.

SINCE THE AJAX PROJECT WAS STOPPED NOT ON TECHNICAL GROUNDS BUT POLITICALLY, A BETTER ANSWER TO THIS QUESTION WOULD COME FROM THOSE WHO WERE INVOLVED IN THAT CAPACITY. TO COMMENT FURTHER ON THIS QUESTION WOULD, I BELIEVE, BE INAPPROPRIATE.

COSTS

FINANCIAL COSTS

PREPARATION OF THE REGION'S SUBMISSION PRIOR TO THE COMMENCEMENT OF THE HEARING	$150,000
PROFESSIONAL TECHNICAL SERVICES DURING THE COURSE OF THE HEARING	$130,000
SERVICES OF LEGAL COUNSEL	$120,000
TOTAL	$400,000

COSTS INCURRED BY THE OTHER PARTICIPANTS ARE NOT AVAILABLE, BUT IF THEY WERE TO BE ACCOUNTED, IT CAN BE EXPECTED THAT THEY WOULD, AT LEAST, EQUAL THE AMOUNT SPENT BY THE PROPONENT.

PHYSICAL COSTS

THOSE ON THE PROPONENT'S PROJECT TEAM OFTEN WORKED VERY LONG HOURS BOTH PRIOR TO THE HEARING AND DURING THE HEARING ITSELF. I BELIEVE THAT SOME OF THE REPRESENTATIVES OF THE CITIZENS GROUP WHO OPPOSED THE PROJECT ALSO WORKED VERY LONG HOURS, AND FOR THEM IT WAS A CONTRIBUTION OF THEIR OWN TIME FOR WHICH THEY DID NOT GET PAID.

PSYCHOLOGICAL COSTS

THIS IS A DIFFICULT QUESTION TO JUDGE SINCE THOSE INVOLVED WERE AFFECTED DIFFERENTLY. THERE IS NO DOUBT THAT FOR SOME IT WAS A VERY STRESSFUL PERIOD.

3rd NATIONAL CONFERENCE
ON WASTE MANAGEMENT IN
CANADA

POLITICS OF SITING HAZARDOUS & NON-HAZARDOUS WASTE MANAGEMENT FACILITIES

OCTOBER 15, 1981

PRESENTED BY:
MAYOR FRANCENE COSMAN
BEDFORD, NOVA SCOTIA

Question No. 1

Why did your group oppose the siting of the landfill? To answer this, I must first explain that in 1975, the Community of Bedford was part of the rural municipality of Halifax County and, as such, was one district out of 21 districts. Our local municipal voice came through one representative on Halifax County Council. The Community, because of this lack of representation had a ratepayers group known as the Bedford Service Commission. This was a group of 10 individuals who were nominated and elected at an Annual Meeting to serve the taxpayers of the community within Bedford, and to deal with local issues such as fire protection, recreation, local planning and street lighting. The Commission's ability to set local area rates, however, became a key factor in the ability to fight the government decision to site a landfill within the District's boundaries. The Bedford Service Commission became the focus of the opposition against the landfill. The primary reason for opposing it in the beginning was on environmental grounds. The 110 acre site chosen for the Jack Lake Dump to handle the garbage of 230,000 people in the region, was on a very small lake situated in the one remaining drumlin of good soil within the community. Coming out of this small lake was a brook which drained into the Paper Mill Lake, a widely used recreational area within Bedford. This brook also happened to run through the small subdivision where I lived. One of my prime reasons for fighting the landfill was the fact that I had bought my home at a substantial investment near this lake, and I was particularly keen on the fact that it was pure and could be used for a number of purposes. I was concerned about my property value, traffic congestion and pollution. The landfill site, as proposed, was in the catchment area of the Sackville

River. Any pollution that potentially could arise from the landfill site would be in this watershed, and flow down through the Sackville River into the Bedford Basin. The Bedford Basin is the narrow body of ocean water in our community which has an extremely slow flushing time and, at the present time, is in a deteriorating state. One of the questions that remained unanswered as a period of time went on concerning the environment was whether or not, because of the nature of the water table there would be a further threat to lakes further out in the watershed beyond the boundaries of Bedford because of the direction of the drainage streams, and these lakes also feed into the regional water supply for our metropolitan area. Our opposition started out on the basis of environmental issues; there is no doubt about that. 88 sites were assessed in 6 weeks; but, as a group, as we became cognizant of more issues than just the environment, our opposition grew stronger because we felt that our basic rights in law as Canadian Citizens were being denied us. Particularly the laws of the zoning regulations of the municipality of the County of Halifax were being ignored by the majority of those elected councillors of the day and, in turn, being ignored by the provincial government of the day. It was a common feeling that if the average man or woman in the community were to break the zoning regulations he or she would end up very quickly in court for doing so; however, in the case of the landfill siting which required a salvage and dump zone, known as S & D, the municipal government and the provincial government of the day refused to apply for a rezoning and refused to go through the public hearing process at which there would have been substantial opposition. In fact, the letters on record asked the province how zoning laws could be circumvented. Thus, out of a beginning on environmental issues, it became a greater question of whether or not we were being denied our rights to a public hearing for a zoning amendment, and eventually whether or not we were being denied our rights under due process of law in a class action suit, and a suit by the Bedford Service Commission against the Province of Nova Scotia and the local tri-municipal board called the Regional Authority which would operate the site.

Question No. 2

Was there significant and geographically widespread opposition?

The opposition was tremendously significant in that it came from a group of professional people who knew how to express themselves well, and where to make themselves heard, including resolutions of support from the Council of Churches. Geographically, the opposition certainly wasn't widespread as it came basically from the community of Bedford which, at that time, had about 6,000 persons living in it.

We were not able to attract other areas within the county to our support, and we rationalized this by saying that perhaps those other areas were afraid it would happen to them next. The most significant factor about our opposition was that it involved utilizing legal methods that were available and, of course, hiring lawyers costs money. But, because we had the Bedford Service Commission, we could afford to set an area rate within Bedford by having the residents vote in the certain amount of expenditure for fighting the legal battle. In the end, the legal cost for the community of 6,000 people totalled up to $62,000. in which we took our case all the way up through the Courts of Nova Scotia to the Supreme Court of Canada. Incidentally, we won.

Question No. 3

Were you involved in the siting process?

No, but, I would have to say at that point in time the provincial government, through its Department of Environment looked at a number of sites and, in particular, a site in Sackville, Nova Scotia, which is a sister community to Bedford, and it chose a number of sites that could potentially afford to have a long term landfill operation. Politics played into the decision of the provincial government to veto using the Sackville site, when the Premier reacted to pressure from 23,000 residents. Not the least of these politics was the fact that the owner of this Sackville land, who had silvicultured forest land for 40 years and who had practically lost his shirt during the depression years, stood out on his property and erected a very large sign and had a very large police dog and a very large rifle. He sat there and threatened to blow off anybody's head who stepped foot on his land or drove on with the first truck full of garbage. It became a very "messy" situation; so called messy because there was a great deal of threatening going on back and forth and, eventually, the Premier of the Province intervened in the Sackville site and said there would not be a dump on that particular location as long as he was Premier! As a result of this, there was a mad scramble to find out where would the most politically expedient location be; in other words, where would you lose the least number of voters in the process of opposition that would arise, and where could you conceivably site this landfill with perhaps moderate to minimum environmental impact. The province, through its Department of the Environment, kept the lid on the whole process; 88 new sites were supposedly evaluated in 6 weeks with minimal staff resources, during the driest summer on record in 103 years. They selected Bedford, all of a sudden, after a very minimal amount of testing at the site area. In fact, the people of Bedford were not aware that this activity was going on. Suddenly, we were hearing on the radio that Jack Lake was the site; even the radio wasn't sure where it was and they weren't saying it was located in Bedford. Only those of us who actually looked at a map quite frequently knew that Jack Lake was in the middle of our small community.

Question No. 4

At what point in the process were you able to express your views? Were they solicited, ignored and finally heard?

The Bedford Service Commission again organized the opposition to the landfill and, as such, our initial views were being expressed through the media (radio, television) through advertising, our public meetings within the community, through petitions and phone campaigns, and through two marches that we made on the Legislative Assembly; and I understand it was the first time that the Assembly ever had a rowdy sit-in with people wearing mink coats and arriving at the door driving cadillacs and mercedes. Because our opposition was quite vocal and vigorous the provincial government decided to hold an Environmental Control

Council Hearing. The Environmental Council was made up of appointed persons from the provincial government under the Department of the Environment, whose function was to sit in session and hear the pros and cons on a particular environmental issue and submit a report to the Legislature. The views of the people of the Bedford area were not solicited. Those views were volunteered freely, and they were given through a series of public hearings in the midst of which we had a bomb threat. The hearings were not particularly conducive to the free flow of information or free flow of speech. One had to write to the Environmental Control Council and ask for permission to speak which, in itself, "put people off" and upon being given permission to appear at the hearing they were called "accredited witnesses." The line of questioning from these witnesses was very stringently controlled in that they had to stick very rigidly to the subject at hand; they could not make comparisons with other landfill sites or other garbage operations, for example, or suggest alternate methods of disposal; but strictly had to address whether the landfill as proposed was going to work at the Jack Lake Site. All the accredited witnesses were denied access to the siting information until 48 hours before the hearings were due to start. This made it extremely difficult to base our arguments on a knowledgeable point of view about hydrology, etc., and it was felt that it was a conspiracy at the time to deny us this information so that we could not make logical and clear arguments as to why we opposed the garbage operation. Our views were undoubtedly ignored, and I say that emphatically because the final report was withheld for 3 months while the Department of Environment staff added comments for clarification. What they actually did was doctor the report, refuting even the recommendations of the Council itself. Incidentally, the Environmental Control Council concluded it was not persuaded that a sanitary landfill should be developed at this site. Then the Minister of Municipal Affairs said he would force special legislation to put the site in Bedford; thus, we started our ongoing battle through the courts;. the lower courts, Provincial Appeals Courts and all the way up to the Supreme Court of Canada. It was only at the Supreme Court of Canada level that one could say our views were finally heard, before Chief Justice Bora Laskin, who decided that we had the right to be heard. The fact that the Chief Justice decided that we had the right to be heard meant that we were going to have to start over again in the lower courts in Nova Scotia. Because this caused such a time delay in the siting of the landfill, the provincial government at that time finally chose another site. You might say that the community of Bedford won, but at whose expense. Certainly we won at the expense of another community which ended up with the landfill in the long run. And, we won at the expense of $62,000.

out of our pockets, and we won at the expense of a tremendous physical and emotional burden on many of us who took part in this.

Question No. 5

Are you still satisfied with the end result?

I am still satisfied with the fact that we kept the landfill out of Bedford. The area that it would have been in would have been highly visible for most of the community, and it is one of the few areas of good soil drumlins in which we will be able to service subdivision and commercial activity at a reasonable cost per linear foot for sewer and water. Most of my community was visited by glaciers eons ago and, as a result, is full of rock which makes servicing extremely expensive, but necessary. The area that would have had the landfill is one of our prime development areas from residential, commercial, and recreational land use, in our future land use strategy.

Question No. 6

Who were the actors - levels of government in this drama?

The actors were the municipal level of government of Halifax County, a rural municipal unit, the provincial government and, in particular, its Department of Municipal Affairs and its Department of the Environment, and the federal government, namely, CMHC who owned the large land bank in the Jack Lake site.

Question No. 7

What changes could have made the process more workable?

The most major change would have been to allow the public to know what was going on first, instead of doing everything shrouded in secrecy and immediately causing everybody to be highly suspicious of the whole procedure. Had the provincial government taken time with the Department of the Environment to employ the input of the public at large in looking for a site in the region, and had the zoning regulations of our own rural municipal county been adhered to, people would not have been nearly as suspicious. But the whole thing was shrouded in secrecy. The meetings at which decisions were made were not public, no minutes were kept, and no press was allowed. Reports were doctored, information was not available, and it was this whole business of everything being done in what appeared to be "under the table" manners that set everybody's teeth to chattering and made us extremely suspicious of the entire process. Good public relations at the start, with public education about landfill operations, would have offset so much reaction.

Question No. 8

Costs: Time and Money, Physical and Psychological.

Costs were $62,000. in legal fees, and what is roughly estimated at $300,000. in lost productivity from those people who gave hundreds and hundreds of hours of their time in organizing the opposition and in lost hours from their jobs, in appearing at public meetings, environmental control council hearings, information sessions, media sessions, public marches, sit-ins, and so forth. Physical and psychological costs: I don't think anybody can begin to describe the stress of being on the opposing side. You begin to question whether or not you really are right in feeling so emotionally strong about such an issue. My community is a professional community of white collar people, lawyers, doctors, and business persons. We were not the kind of people who marched on the Legislative Assembly when all this began. As I said earlier, it was a surprise to have people marching on the Assembly wearing mink coats and driving cadillacs, e tc. You really begin to wonder if you are going through a crisis of identity and revolt, where suddenly you are seen as some kind of radical, and you are being cartooned in the newspapers and lied about in the Legislative Assembly. At one point in time, we were accused of vandalising the legislature and ripping pipes off the building, etc. However, none of this ever happened. But, because we were accused of this, a lot of us literally got a black eye. Psychological costs: I would have to say that it strained a lot of relationships because, in certain families, perhaps the husband was involved and the wife wasn't, or vice-versa. There are still a lot of people who expect their dinner on the table when they come home from work, and if their wife is out fighting a dump site, and the children are home without a baby sitter, they get their back up. There was a lot of psychological stress because it split a community initially; but in the long run the entire community pulled together on this issue and, I would have to say, that because of the dump or the landfill Bedford as a rural district in a rural municipal unit, decided that it was no longer happy with that relationship and it felt that if we were not listened to in terms of the zoning regulations and so on, and that if a senior level of government could come along and say "look, we're going to put a landfill in your community come hell or high water" that this wasn't good enough government for us and, as such, it startaed the move toward independence in our community. We finally became a separate municipal unit of our own, namely, the Town of Bedford. It was the first time in 57 years in the province that a new town was incorporated, and I would have to say that it was the direct result of the fact that we became so unhappy with our local government over this garbage issue. It's the first time a new town was incorporated because of a garbage fight. The opposition was successful, its scars still run deep, but it proved one thing: that is, that any environmental issue is an extremely difficult and emotional thing to fight, but if you have time on your side, and money and you believe you're right, then you really should go after it.

The statement frequently was made "Democracy fails when the voice of the people is not heard." Our small voice turned into a roaring lion which saw the defeat of the government in power at the time, and led to the Incorporation of a new town in Nova Scotia.

October 15th - 10:40 - 12:10 p.m.

Planning of Facilities

Moderator: Rod McRae
Operations Division
City of Winnipeg, Manitoba

Panelists: Warren Wilson
Reid, Crowther and Partners Ltd.
Toronto, Ontario
(Western Canada)

Orlando Martini
MacLarens
Toronto, Ontario
(provincial)

Romeo Palombella
Region of Hamilton-Wentworth
Hamilton, Ontario
(municipal)

FACTORS INVOLVED IN THE DEVELOPMENT OF A HAZARDOUS WASTE MANAGEMENT PLAN FOR NORTHERN AND WESTERN CANADA

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ABSTRACT

This paper highlights several factors involved in the planning of a comprehensive waste management system designed to handle the estimated 260,000 tonnes of hazardous chemical wastes generated each year in Northern & Western Canada. These wastes are the residues from the manufacturing processes that supply the vast range of products demanded by our modern society.

The recommended system provides a network of collection stations throughout the geographic area with a transportation system for delivering wastes to regional treatment plants located in each of the four western provinces. A single high temperature incinerator would be located in Alberta for the destruction of organic wastes. the system allows for the treatment of wastes in the same part of the region in which they are generated, wherever this situation is both operationally and economically feasible. The system should be owned by a Crown Corporation, financed by the participating governments, and monitored by the provincial and territorial government agencies that would have an arms-length relationship with the Corporation.

A recommended 5 year implementation program has been based on the assumption that the various territorial, provincial and federal agencies will continue to support the concept of regional cooperation and will together proceed with the implementation of the various components of a regional system. The program has sufficient flexibility to allow one province or territory to take action ahead of another, or even operate quite independently. No matter which approach is taken, the successful implementation of a system is a considerable undertaking and, will not be accomplished without dedicated effort and cooperation. The issue of cooperation extends beyond the government agencies. All members of the public, industry, and the media will be required to dedicate a similar degree of effort and understanding if an acceptable system is to be achieved.

FACTORS INVOLVED IN THE DEVELOPMENT
OF A HAZARDOUS WASTE MANAGEMENT PLAN
FOR NORTHERN AND WESTERN CANADA

A. Warren Wilson and John M. Atkinson

BACKGROUND

In the autumn of 1979, Reid, Crowther & Partners Limited was retained by Environment Canada in Association with the Provincial Governments of British Columbia, Alberta, Saskatchewan, Manitoba, and Ontario, as well as the Territorial Governments of the Yukon and Northwest Territories, to conduct a feasibility study for hazardous waste management in Northern and Western Canada. The geographic area covered by this study encompassed that part of Canada to the west of a meridian passing through Marathon in Northwestern Ontario. This study was funded half by the Federal Government and half by the Provincial and Territorial Governments. This latter half was divided in proportion to the respective populations in each jurisdiction covered by the study area.

The scope of the feasibility study included:

- Determination of the need for a hazardous waste management system in Northern and Western Canada by examining existing practices and making a preliminary inventory of hazardous wastes potentially available for shipment to one or more central processing and disposal facilities.

- A review of available processing and disposal technologies for hazardous wastes.

- A screening of alternate waste management systems and definition of preferred systems that warranted detailed evaluation.

- Preparation of conceptual engineering descriptions of the preferred alternative systems together with an evaluation of each using economic, social, environmental, risk, and engineering criteria.

- Selection of candidate areas for the siting of waste management facilities in each of the four Western Provinces.

- Development of implementation program describing system ownership options, legislation requirements, public consultation requirements, and further site selection work.

This paper highlights some of the major factors that came into play in course of developing the waste management plan for Northern and Western Canada. A three volume report detailing the results of the feasibility study has been prepared. This report was released to the Public by the various Government Agencies in the Spring of 1981 (1) (2) (3).

INITIAL CONSIDERATIONS

The major features considered in the early stages of development of the hazardous waste management plan included:

- Waste quantities
- Waste types
- Location of waste sources
- Geography
- Technology.

Inventory:

The first three items above were determined by preparing an inventory of hazardous wastes generated in the geographic area. This inventory considered only wastes that would be likely candidates for processing and disposal at central facilities. The methodology used to prepare the inventory is described in detail in the Volume 1 report (1). Suffice to say here that a total of about 260,000 tonnes per year of hazardous wastes were identified as being candidates for processing and disposal at central facilities. The breakdown of this quantity into various wastes categories is shown in Table 1. The major industrial centres accounting for about 80% of this total are Vancouver, Edmonton, Calgary, Saskatoon, Regina, and Winnipeg. The balance originates mainly from the resource extraction development scattered throughout the geographic area under investigation.

Geography:

Two geographic features are immediately apparent on first examining the study area:

- the area is very broad and covers almost half the country
- the predominant natural feature is the Western Cordillera.

The first point above leads to the general concept of several collection stations connected by a transportation network to central processing and disposal plants. The collection stations would be established at judiciously selected locales in the remote parts of the study area. These collection stations would be depots to which wastes generated in a given region can be transported for assembly or bulking into larger loads for the long haul to central processing and disposal facilities. Depending upon the economics of the situation, it may be desireable to include some form of pretreatment (i.e. neutralization, precipitation, dewatering, etc.) into certain collection stations to reduce the quantities required for the long haul to the central disposal plant.

The second point above historically has resulted in a network of established transportation routes across the study area. These routes will be used for the transportation of wastes from collection stations to central processing and disposal plants. For example, the Alaska Highway is the well-travelled route that connects the Yukon Territory with Fort St. John and Dawson Creek in British Columbia to Grande Prairie in Alberta and on to Edmonton. Likewise the MacKenzie Highway connects Yellowknife, Hay River, Fort Smith, and Pine Point in the Northwest Territories with Edmonton via Peace River in Alberta. As a third example, the resource extraction industries in the East Kootenays of British Columbia are closer by road via the Crows Nest Pass then to the central interior or to the west coast of British Columbia. Therefore a transportation network connecting the collection stations to the central processing and disposal plants was established based upon current patterns in the flow of goods and services.

Eight geographic regions were considered for treatment and disposal facilities. These regions were selected to allow facilities to be located near major waste generation centres and also in areas that could be more suitable for siting in terms of environmental, social and geological criteria. The locations of the regions were as follows:

1. Lower Mainland British Columbia region: Vancouver area
2. Southern Interior British Columbia region: Kamloops area
3. Central Alberta region: Edmonton area
4. South East Alberta region: Medicine Hat area
5. Central Saskatchewan region: Saskatoon area
6. Southern Saskatchewan region: Regina area
7. Southern Manitoba region: Winnipeg area
8. Northwest Ontario region: Thunder Bay area

The exact description of these regions is vague. For example, a facility in the Regina area might be sited within a 100 kilometer radius of the City of Regina.

Technology:

In developing the conceptual design of the regional treatment plants, consideration was given to providing facilities that will afford the maximum protection of human and animal health, as well as the water, air and land environments - all being consistent with currently available proven technology.

Accordingly whenever possible, all wastes either will be rendered non-hazardous by some form of physical and chemical treatment, or will be destroyed by thermal destruction. Solidified residues will be deposited in a secure landfill. Aqueous discharges from dewatering operations will be held either for pre-treatment prior to discharge or disposed of in natural evaporation ponds. Exhaust gases from the thermal destruction process will be routed through a gas cleaning train.

A generalized block diagram illustrating the basic processing steps for the treatment and disposal of hazardous wastes at any one of the regional treatment plants is presented in Figure 1. In summary the proposed waste treatment system incorporates the following steps:

- Detoxification, neutralization and chemical precipitation of liquid inorganic wastes.
- Dewatering of sludges (including those produced as a result of the detoxification, neutralization and precipitation steps above).
- Dewatering of oils and recovery of as much waste oil as possible for re-refining.
- Recovery of solvents whenever possible.
- Thermal destruction (by means of a rotary kiln incineration system) of all organic liquids, sludges, pastes and solids.
- Solidification of fluid residues designated for secure landfilling.
- Treatment of aqueous discharges from the neutralization, precipitation, and sludge and oil dewatering steps for removal of any residual contaminants prior to discharge to the environment.

Initial Screening of Possible Waste Management Systems:

Given eight location options for the central processing and disposal facilities and other options for putting any one or combination of physical/chemical treatment, incineration, and secure landfilling at each location, there are thousands of hypothetical alternative systems that can be divised. However most of these do not make practical sense so a list of 56 realistic alternatives was subjected to a preliminary examination on the basis of cost, as well qualitative preferences covering environmental, social, political, and risk issues.

The result of the initial examination was the identification of a "preliminary preferred" system. This system incorporated complete treatment facilities in the lower mainland of British Columbia and in Central Alberta. Secure landfills required for the disposal of residuals from these plants were located in the southern interior of British Columbia and in southeastern Alberta respectively. A physical/chemical treatment plant and secure landfill were designated for each of the southern Saskatchewan and Manitoba areas. Incinerable materials from these Provinces would be transported to the central treatment plant in Alberta for thermal destruction. The possibility of a complete treatment plant at some future date if required for Saskatchewan and Manitoba was also indicated. Hazardous wastes generated in the Yukon and Northwest Territories and the East Kootenays and Peace River District were directed to Alberta for treatment and disposal. Likewise hazardous wastes generated in northwestern Ontario were directed to Manitoba for treatment and disposal.

ALTERNATIVES SUBJECT TO DETAILED REVIEW

The description of variations of the basic system permits an examination of three important questions that are of interest to members of both the public and private sectors:

- Should facilities be located close to waste generators or should they be sited in areas of low population density?
- To what degree should incineration facilities be centralized?
- What are the consequences of providing entirely independent operations in each of the four western provinces?

These questions were the basis for developing the nine alternatives and the evaluation of these alternatives provides a response to the questions posed. The nine alternatives subjected to a detailed review were divided into four groups as described below the groups.

Series 1 Alternatives: (See Figure 2)

These three alternatives are based on the use of a single incinerator for the destruction of organic wastes from the entire geographic area, with processing facilities located near major sources of waste generation in each of the western Provinces.

Alternative 1A. A "base case" to establish the consequences of locating processing and disposal facilities near major waste generation points which minimizes transportation requirements.

Alternative 1B. A variation of 1A which recognizes that engineering feasibility, environmental and social pressures may require that the secure landfill location be restricted to more southerly regions in Alberta and Saskatchewan.

Alternative 1C. A variation of 1A that recognizes that environmental and social forces may require that the incinerator complex also be located remote from a main population centre.

Series 2 Alternatives: (See Figure 3)

These alternatives are based also on the use of a single incinerator facility to serve the entire geographic area. However, all treatment facilities are located away from major population centres.

Alternative 2A - In this alternative, treatment and disposal facilities are located in the B.C. Interior, and in the southern parts of Alberta, Saskatchewan and Manitoba remote from major population centre.

Alternative 2B - A variation of 2A in which wastes from Alberta and Saskatchewan are combined for treatment at one site.

Series 3 Alternatives: (See Figure 4)

These alternatives are based on the use of two incinerator facilities in the region - one located to the west of the Rocky Mountains, the other to the east.

Alternative 3A - This alternative is similar to alternative 1B, with the exception that a second incinerator is located in British Columbia.

Alternative 3B - A variation of 3A that permits the examination of the consequences of locating the eastern incinerator facility in Saskatchewan rather than Alberta.

Series 4 Alternatives: (See Figure 5)

These alternatives are based on each of the four western Provinces providing treatment and disposal facilities capable of processing and disposing of all wastes generated in their Provinces on an independent basis.

Alternative 4A. This alternative provides for complete treatment facilities that are located away from major population centres.

Alternative 4B. A variation of 4A in which treatment facilities are located near a major source of waste generation in each of the western Provinces but the secure landfills are located in the more southernly areas.

EVALUATION CRITERIA

The evaluation of the advantages and disadvantages of the alternatives is facilitated by developing various criteria. Some criteria can be quantified; others can only be described and applied in a subjective manner. Consequently, the consolidation or addition of the measurements of criteria is difficult due to the variable nature of individual criteria. The assessment of the alternatives using a single criterion, the weighting of the relative importance of each assessment, and the grouping of the information to provide a conclusion, always will be highly debatable decisions with individual preferences dependent on the background and objectives of the individuals or groups involved.

Five criteria were used to assess the alternative systems:

- System Cost
- System Risk
- Operational Feasibility
- Environmental Impact
- Social Impact

Each alternative has been ranked using the individual criteria. The ranking process results in the alternative systems being placed in one of three categories ranging from most preferred to least preferred and awarded scores ranging from 1 to 3 respectively. A rationale for the placement of the alternatives within the ranking groups is discussed below. The use of a number system has been selected to produce a quantitative display of the results and to allow for a method of adding the assessments to produce some indication of overall ranking.

System Cost:

The initial annual cost, or first year cash-flow requirements for each alternative as presented in the original feasibility study report are listed in Table 2. In allowing for inflation over the intervening year and adjusting the interest rate to 20 percent, the "total annual cost" and "cost per tonne" should be increased by about 30 percent. However this will have little impact on assessing the economics of the alternatives relative to one-another.

The ranking of the alternatives with respect to system cost was done using the following scoring system:

Relative Cost	Score
Least	1
Intermediate	2
Greatest	3

The results are shown in Table 3. The variations in total system costs are due primarily to the costs of providing incinerator units in each Province rather than a large central incinerator in one Province. Other factors, such as variations in transporation costs, also influence the difference in costs between the alternatives. However, the effect of these factors is small in comparison to the incineration system considerations.

System Risk:

The system risk has been considered to have two components: the risk of spills during transportation movements, and the risk of operational failures at collection and treatment plant sites.

Transportation Risk will be highly correlated with the total distance travelled by transport vehicles in moving waste from the collection stations to the treatment facilities and between the treatment and disposal facilities. The risks associated with transporting wastes from the generators to the collection stations will be the same for all alternatives. The larger values of distance and spill risk tend to be associated with alternatives in which there are fewer facilities, and in which facilities are located in an area remote from the locations where waste is generated. As the risk is related to distance travelled, this factor can be used to group the alternatives into three risk categories as follows:

Transportation Risk	Scoring	Identifying Characteristics
Least	1	Least transport distance
Intermediate	2	Intermediate transport distance
Highest	3	Greatest transport distance

The resulting scoring is indicated in the second column of Table 4. The reader wishing to review a more detailed treatment of the transportation risk question is urged to consult Volume 3 of the final report (3).

Plant Operational Risks can be mitigated by good design and operating procedures. The risk of operational failures resulting in conditions such as unacceptable emmissions will be increased by increasing the number of facilities. This concern relates, in particular, to incinerator exhausts which are dispersed into the atmosphere after treatment. The consequences of a mishap could be more serious if the treatment facility were located near an urban area.

Three categories of plant operational risk have been assigned as follows:

Operational Risk	Scoring	Identifying Characteristics
Lowest	1	Single incinerator site
Intermediate	2	Two incinerator sites
Highest	3	Four incinerator sites

The scorings are listed in column 3 of Table 4.

An overall system risk rating has been obtained by arbitrarily adding the plant and transportation and plant operational risk scores and arranging the values into three categories. This sum and the overall risk rating are presented in the fourth and fifth columns respectively of Table 4.

Operational Feasibility:

The nine alternatives each have an important distinguishing feature in the number of incinerator plants provided. The nature of incineration systems results in operational disadvantages being associated with alternatives containing several incinerator plants. These disadvantages are discussed under the following sub-headings.

- Equipment Scale Factor - Below a throughput of about 15000 tonnes per year, equipment size restrictions limit the ability of the kiln to successfully process certain solid waste shapes and sizes including drums containing waste materials. Therefore if Manitoba, Saskatchewan, and British Columbia were each to generate an independent system, the rotary kiln sizes required to meet their individual demands would have limited operational flexibility.

- Supplemental Fuel Requirements - It is desirable to have as many waste solvents and other high calorific value waste materials as possible available as a supplemental fuel at the thermal destruction plant charged with responsibility for destroying wet wastes and sludges or other materials with a low heating value.

- Stable Operating Conditions - To achieve as stable operating conditions as possible for the thermal destruction train, a uniform waste feed is required. The opportunity for successful blending to produce a consistent feed stock is reduced if the choice of waste materials drawn upon is also reduced by having multiple incineration systems rather than a central plant.

- Provision of Laboratory Facilities - Due to the almost limitless variety of organic wastes that could be received at the thermal destruction plant, a highly sophisticated laboratory incorporating sampling, monitoring and analytical equipment and bench-scale test burn facilities, equivalent to best available technology, will be required. It would be easier, more desirable and efficient to provide these facilities and the highly specialized laboratory staff to run them at one central location rather than at four regional locations.

- Need for Trained Staff - The feed preparation, incineration, and gas cleaning steps of the thermal destruction complex must be properly controlled and operated as an integrated system. A highly trained, technically sophisticated and well disciplined operating staff will be required to operate, maintain, and monitor the facility. There would be a better chance of acquiring and keeping a trained reserve of such specialist talent at one central incineration plant location than at four regional locations.

On the basis of engineering feasiblility of operation, the alternatives have been assigned to three groups and scored as follows:

Operational Feasibility	Score	Identifying Characteristics
Most	1	Single incinerator for the geographic area
Intermediate	2	Two incinerators for the geographic area
Least	3	Four incinerators for the geographic area

Environmental Impact:

Detailed evaluation of environmental impacts requires site specific information on the project components and a site specific description of the natural environment. As this information will not be available until a later stage in the implementation program, a quantified comparison of the alternatives cannot be made.

In general, many impacts can be eliminated or greatly reduced by design solutions, and in particular, the site selection method should be designed to avoid environmentally sensitive areas. Therefore, the predicted impacts on the natural environment are likely to be similar for all variations. The only difference that can be identified at this stage is that alternatives with the greatest number of processing and disposal facilities are potentially subject to a larger number of environmental impacts.

For the purposes of this evaluation, alternatives with six or more component treatment and disposal facilities have been assessed two points for greatest potential environmental impact. Alternatives with less than six components have been scored one point for least impact potential. The environmental impact of the proposed facilities is not deemed to be of sufficiently negative magnitude to warrant any of the alternatives being awarded a score of three points.

Social Impact

Social impacts are difficult to quantify and such measurement can only be approached by surveying a wide base of interests. The public is almost always disinterested in cost comparisons and is not swayed by descriptions of technological solutions. The primary public concerns are questions of risk, environmental safety, public health, ownership and monitoring responsibilities, and site locations that do not threaten community health, aesthetics, or property values.

Provided that transportation risks are minimized, social impacts will be reduced if facilities are sited remote from communities, especially facilities that are involved either in long term care disposal or detoxification and destruction of the more hazardous waste materials.

Therefore the following scoring system was devised to account for social impact:

Social Impact	Scoring	Identify Characteristics
Least	1	Remote locations for incinerators & secure landfills
Intermediate	2	One or two of either an incinerator and/or a secure landfill located near large population centres
Highest	3	All others

EVALUATION OF ALTERNATIVES

The results of the evaluation of the alternatives under the five criteria headings are summarized in Table 5. A footnote to the table provides a summary of the rationale for applying the evaluation criteria, and a statement of the point score ranking.

An indication of an overall ranking can be obtained by arbitrarily summing the point scores. In so doing, some recognition is given to the relative importance of the criteria and the different nature of the criteria (quantifiable economic values at one extreme versus qualitative social values at the other) by giving a "weighting" of one to some criteria and zero to others as desired. Table 6 provides a number of examples of the overall ranking by summing the point scores for different combinations of the assessment criteria. This approach of considering the criteria in different combinations permits the sensitivity of the overall ranking process to different weightings, or even evaluator perspectives, to be judged.

Reference to Table 6 indicates that the overall rankings are not too sensitive to the use of the assessment criteria, and in all cases Alternative 1C is ranked as a preferred alternative. However it is only marginally better than a few of the other alternatives - notably Alternatives 2A and 2B.

SITE SELECTION

A three phase site selection program for locating the hazardous waste central processing and disposal facilities was developed. This program is illustrated in Figure 6. In Phase 1, broad candidate areas are identified by means of a constraint mapping techinque. In Phase 2, a large number of possible sites within these candidate areas are identified and by decision-tree analysis and detailed mapping investigations, this number is reduced to a short list of candidate sites. In Phase 3, site-specific data are gathered on each candidate site and, by application of site specific criteria developed in association with the preliminary facility design work, one (or more) preferred site(s) are selected.

The Hazardous Waste Management Plan Study for Northern and Western Canada proceeded to the end of Phase 1 of the site selection work. A number of candidate areas in which to find candidate sites for the processing and disposal facilities in the four western Provinces have been indentified. A description of the constraint levels used in the Phase 1 site selection work is presented in Table 7.

IMPLEMENTATION

The implementation program comprises all of the activities that follow the decision to proceed with a regional system. The definition of a practical implementation program is of critical importance. The major tasks of the implementation program are as follows:

- Implementation of a comprehensive public participation process to be in operation throughout the course of the program.
- Confirmation of key policy decisions on inter-government cooperation, system ownership, and financing.
- Implementation of a legislation package suitable for the approved system.
- Continuation of the site selection process as initiated in this report, leading to the final selection and approval of sites for all components of the system.

The implementation program will require other activities to be undertaken in addition to those listed. Environmental studies, site investigations, detailed designs, construction operations, are examples of such activities. The following discussion provides background information and recommendatins on some of the major task areas and presents an outline of an implementation schedule that coordinates all tasks into a systematic program.

System Ownership Considerations;

There are a number of ownership options for the treatment and disposal components of a hazardous waste management system. The basic alternatives are private ownership, industry cooperative, public ownership by a government agency, and public ownership by a Crown Corporation. The discussion of ownership options in the study (3) was based on financial, environmental and social considerations. The conclusion reached was that the waste management system should be operated by a Crown Corporation, financed by the participating governments(s), and monitored by the provincial and territorial regulatory agencies that would have an arms-length relationships with the Corporation. It is also concluded that the private sector would have an important role in providing the transportation component of the system on contract to the Corporation. The transportation industry is well established in the region and has the ability and expertise to run cost effective services under the contracted control of the Corporation.

Revenue for the operation should be based on a user pay basis with the Crown Corporation operating as a regulated utility. The user charge would be made up of a transport cost plus a treatment and disposal cost.

Legislation Considerations:

An important requirement for any hazardous waste management program is an effective system of legislation, regulation and enforcement. The report identifies deficiencies in the existing system and provides checklists of legislative and regulatory requirements. The highest priority issues which should be addressed immediately are as follows:

- Implementation of a mainifest system for tracking wastes.
- Licensing of solid and liquid hazardous waste haulers.
- Stricter licensing and monitoring of landfills accepting hazardous wastes.
- Penalties of sufficient magnitude to discourage improper disposal.
- Mandatory recycling and reuse of specific waste streams whereever economically feasible.

The Site Selection Process

One of the most important tasks of the implementation prgram will be to continue with the siting process. The next ste (phase 2) is to proceed from the "candidate area" information to a selection of "candidate sites". this may be accomplished by developing a detailed list of criteria, collecting data to describe the criteria, analyzing the data and thus identifying acceptable sites. These sites would then be examined for their suitability to meet specified site area requirements. The most suitable sites would be considered as "candidate sites".

The final step (phase 3) of the process provides a detailed comparison of the candidate sites and will require field studies to collect site specific data. Design layouts would be prepared for the sites under consideration and the final comparisons would lead to the definition of "preferred sites".

Implementation Program Schedule:

The recommended implementation program is illustrated in Figure 7. It is based on the assumption that the various provincial, territorial and federal agencies will support the implementation of a regional plan. The program has sufficient flexibility to allow one province of territory to take action ahead of another, or even to operate quite independently. No matter which approach is taken, the successful implementation of a system is a considerable undertaking and will not be accomplished without dedicated effort and cooperation. This issue of cooperation extends beyond the government agencies. All members of the public, industry, and the media will be required to dedicate the same degree of effort and understanding if an acceptable system is to be achieved.

The fundamental objective of the implementation program is the rational development of a waste management system that will treat the hazardous wastes of Northern and Western Canada. The system would be introduced according to socially approved tenets and recognized standards of environmental protection. Appreciable costs, in one form or another will accompany the introduction of the system, but these could pale in significance to the costs potentially accruing to a society that either fails to treat the widespread problems of hazardous waste management or finds solace in incomplete solutions.

REFERENCES

(1) ENVIRONMENT CANADA, "Hazardous Wastes in Northern & Western Canada - Volume 1, Assement of Need," prepared by Reid, Crowther & Partners Limited, February 1980.

(2) ENVIRONMENT CANADA, "Hazardous Wastes in Northern & Western Canada - Volume 2 Technology Review," prepared by Reid, Crowther & Partners Limited, December 1980.

(3) ENVIRONMENT CANADA, "Hazardous Wastes in Northern & Western Canada - Volume 3, Development of a Waste Management Plan," prepared by Reid, Crowther & Partners Limited, March 1981.

TABLE 1

APPROXIMATE QUANTITIES OF HAZARDOUS WASTES GENERATED ANNUALLY IN NORTHERN & WESTERN CANADA

Liquids 238,000,000 L (approx.)	
Oils	31%
Acids	23%
Chemicals	18%
Alkalis	7%
Solvents (Non-Halogenated)	4%
Metal Sludges	3%
Solvents (Halogenated)	2%
Tank Bottoms	2%
Cyanides	1%
Infectious Wastes	1%
Photo Chemicals	1%
Paints	1%
Balance	6%
TOTAL	100%

Solids 22,000,000 kg (approx.)	
Acids	41%
Contaminated Soils	33%
Metal Sludges	9%
Containers	4%
Fly Ash	4%
Infectious Waste	2%
Asbestos	2%
Waste Activated Carbon	1%
Balance	3%
	100%

TABLE 2

ESTIMATED AVERAGE UNIT COSTS FOR HAZARDOUS WASTE DISPOSAL IN NORTHERN AND WESTERN CANADA (1980 DOLLARS)

Alternative No.	Capital Cost ($$10^6$)	Amortized Capital Cost ($$10^6$)*	Annual Operating Cost ($$10^6$)	Total Annual Cost ($$10^6$)	Cost Per Tonne
1A	$ 71.123	$ 9.523	$22.043	$31.566	$121
1B	70.124	9.390	22.280	31.670	122
1C	71.302	9.547	22.093	31.640	121
2A	73.619	9.858	24.969	34.827	134
2B	65.370	8.753	23.192	31.945	123
3A	85.908	11.503	24.979	35.482	136
3B	85.578	11.191	23.724	34.915	134
4A	108.690	14.554	29.872	44.426	171
4B	108.762	14.563	27.200	41.763	160

* Capital recovery factor for 12% interest over a 20 year amortization period = 0.1339. Current (late 1981) costs could be as much as 30 percent greater than those indicated above due to inflation during the intervening time and interest rates in excess of 20 percent.

TABLE 3

COST EVALUATION

Alternative	Annual Cost (million $ 1980)	Grouping	Point Score
1A	31.566	Least Cost	1
1B	31.670		1
1C	31.640		1
2B	31.945		1
2A	34.827	Intermediate Cost	2
3A	35.482		2
3B	34.915		2
4A	44.299	Greatest Cost	3
4B	41.763		3

TABLE 4

SYSTEM RISK EVALUATION

Alternative	Transport Ranking	Plant Ranking	Sum	System Ranking
1A	1	2	3	1
1B	2	2	4	2
1C	2	1	3	1
2A	3	1	4	2
2B	3	1	4	2
3A	1	2	3	1
3B	1	2	3	1
4A	3	3	6	3
4B	1	3	4	2

TABLE 5

SYSTEM EVALUATION SUMMARY [1]

CRITERIA	ALTERNATIVE 1A	1B	1C	2A	2B	3A	3B	4A	4B
System Cost	1	1	1	2	1	2	2	3	3
System Risk	1	2	1	2	2	1	1	3	2
Operational Feasibility	1	1	1	1	1	2	2	3	3
Environmental Impact	1	2	2	2	2	2	2	2	2
Social Impact	3	2	1	1	1	2	2	1	3

[1] The numbers listed in the table indicate the evaluation of each alternative by each criterion. The alternative is placed into one of three groups as follows,

1 = least cost, risk, environmental impact and social impact, and most feasible operation.

2 = intermediate conditions.

3 = greatest cost, risk, environmental impact and social impact, and least feasible operation.

The reasons for assigning a particular number of each of the alternatives are discussed in detail the text of Chapter 3 of reference (3).

TABLE 6

RANKING OF THE ALTERNATIVES
(GIVING CONSIDERATION TO DIFFERENT COMBINATIONS OF CRITERIA)

CRITERIA EMPLOYED	ALTERNATIVE								
	1A	1B	1C	2A	2B	3A	3B	4A	4B
Cost Risk Op. Feasibility Env. Impact Social Impact	7*	8	6	8	7	9	9	12	13
Risk Op. Feasibility	2	3	2	3	3	3	3	6	5
Risk Social Impact	4	4	2	3	3	3	3	4	5
Risk Op. Feasibility Social Impact	5	5	3	4	4	5	5	7	8
Risk Op. Feasibility Env. Impact Social Impact	6	7	5	6	6	7	7	9	10
Cost Op. Feasibility	2	2	2	3	2	4	4	6	6

NOTE: The scores listed in this table are the sum of the scores for the criteria noted for each alternative. The heavily circled numbers in each row indicate the most preferred alternative(s) for that combination of criteria employed in the evaluation of the alternatives for that row. The lightly circled numbers indicate the second most preferred alternative(s) for the same combination of criteria.

* For example in Table 6, Alternative 1A has a total score of 7 for the criteria as listed in Table 5:

Cost	1
Risk	1
Feasibility	1
Environmental Impact	1
Social Impact	3
TOTAL	7

TABLE 7

CONSTRAINT LEVEL DESCRIPTIONS

	MAJOR	MODERATE	MINOR
GEOLOGY	Coarse grained alluvium, colluvium, glacial outwash, buried channels and organic terrain. Fractured or high permeability bedrock at shallow depth; breccia, coal. Excessive erosion or slope instability potential; faulting.	Granular moraine deposits moderately permeable bedrock at shallow depth, basalt, carbonates.	Lacustrine silts and clays; low permeability unfractured bedrock, thick geological units.
GROUNDWATER	Coarse grained alluvium aquifers and high porosity/permeability bedrock aquifers. Includes outwash, deltaic and buried valley as deposits. All known and potential aquifers as well as all areas with long term yields in excess of 0.1 L/s. Major areas of flowing wells.	Low yielding bedrock aquifers with marginal water quality i.e. long term yields 0.1 to 0.4 L/s and TDS greater than 2000 mg/L. May be acceptable site if confined laterally and at depth.	Thick deposits of low permeability surficial silt and clays; thick unfractured bedrock, groundwater if present is non-potable (>3000 mg/L TDS). Known water tables at least 20 m deep.
SEISMIC RICK	Earthquake hazard potential is high (seismic zone #3). Acceleration ratio, A>0.06.	Earthquake hazard potential is moderate (seismic zone #2). Acceleration ratio, A 0.06 - 0.03.	Earthquake hazard potential is low (seismic zone #1 and 0). Acceleration ratio is A>0.03.
CLIMATE	Annual precipitation rate exceeds 800 mm, and may be excessive for extended periods of climatic cycle, annual net evaporation is below 200 mm.	Annual precipitation is moderate 500-800 mm and may be excessive for short periods. Annual net evaporation is 200-300 mm.	Annual precipitation is below 500 mm and excessive deposition is rare. Annual net evaporative capability of region is high (exceeding 300 mm) and is generally in balance with precipitation patterns.
LAND CAPABILITY	Lands in this category are of prime importance (Canada Land Inventory Classes 1 to 3) for a combination of any two or more of the following potential resource uses: agriculture, forestry, recreation, ungulates and waterfowl.	Lands in this category are of prime importance for one of the following resource uses: agriculture (Class 1 to 3), forestry (Class 1 to 3), ungulates (Class 1 and 2) and waterfowl (Classes 1 and 2).	Lands in this category are not of prime importance for any of the following resources uses: they are Classes 4 to 10 > for agriculture, forestry and recreation and CLI Classes 3 to 7 for ungulates and waterfowl.

FIGURE 1

TREATMENT SYSTEM BLOCK DIAGRAM

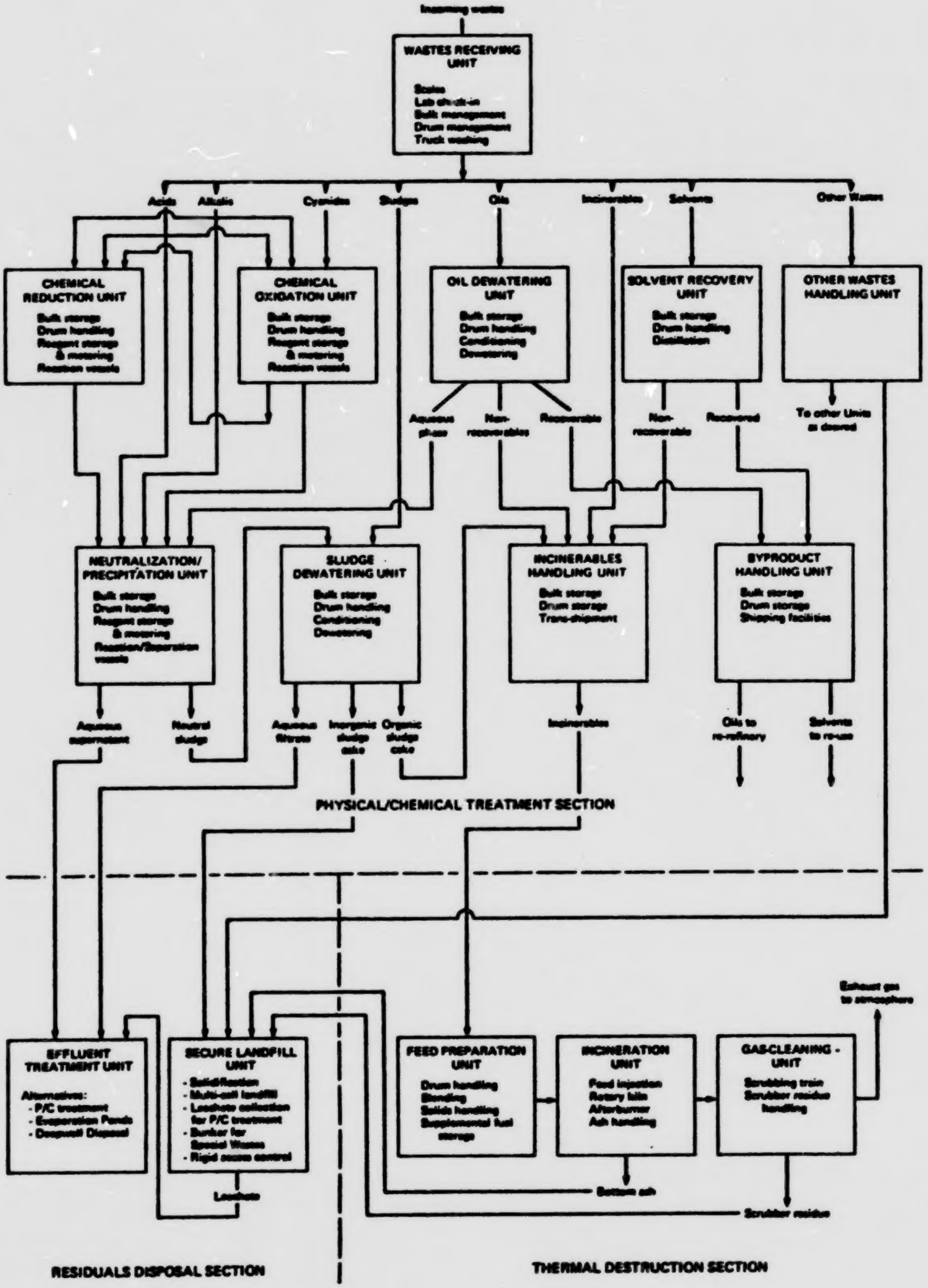
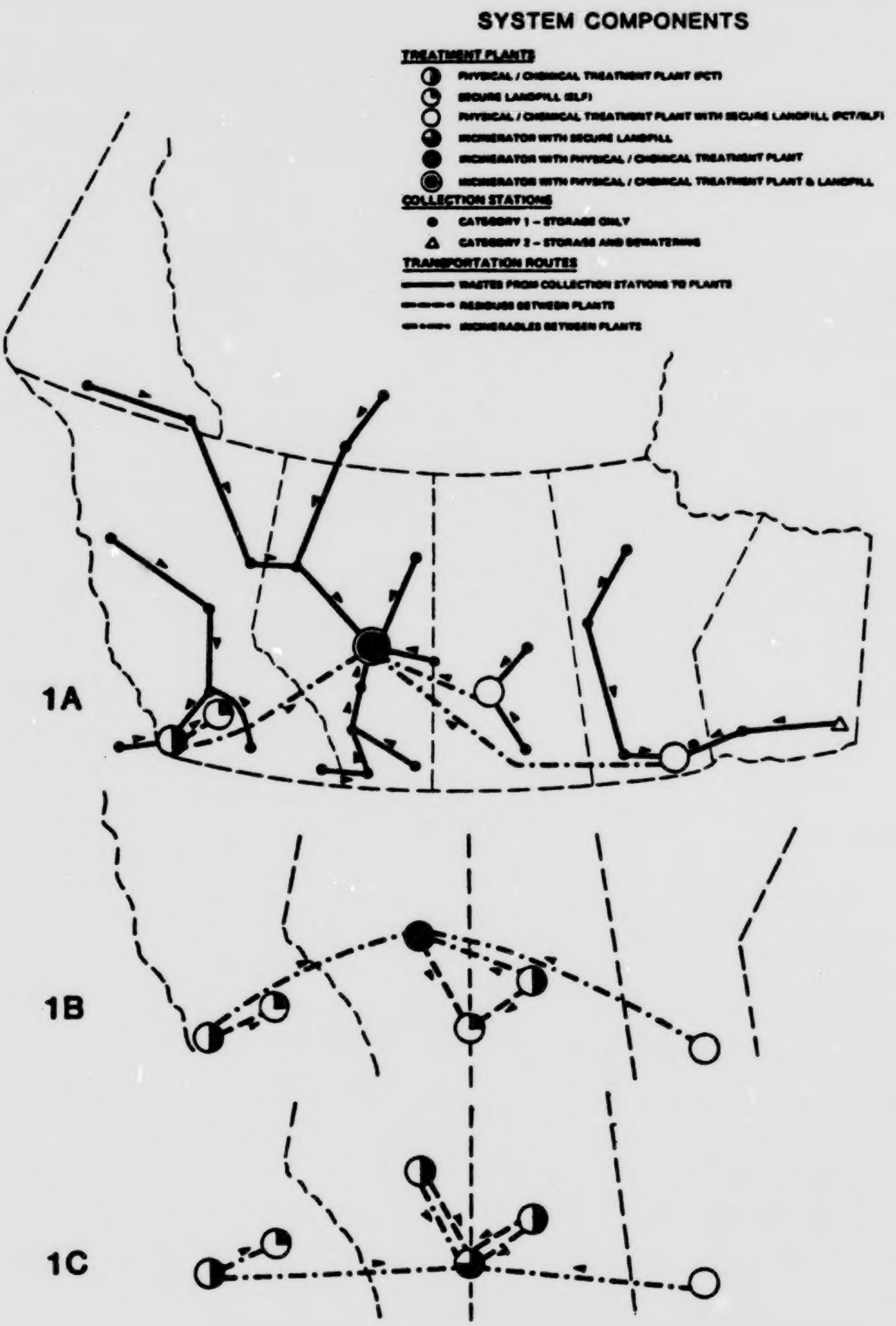


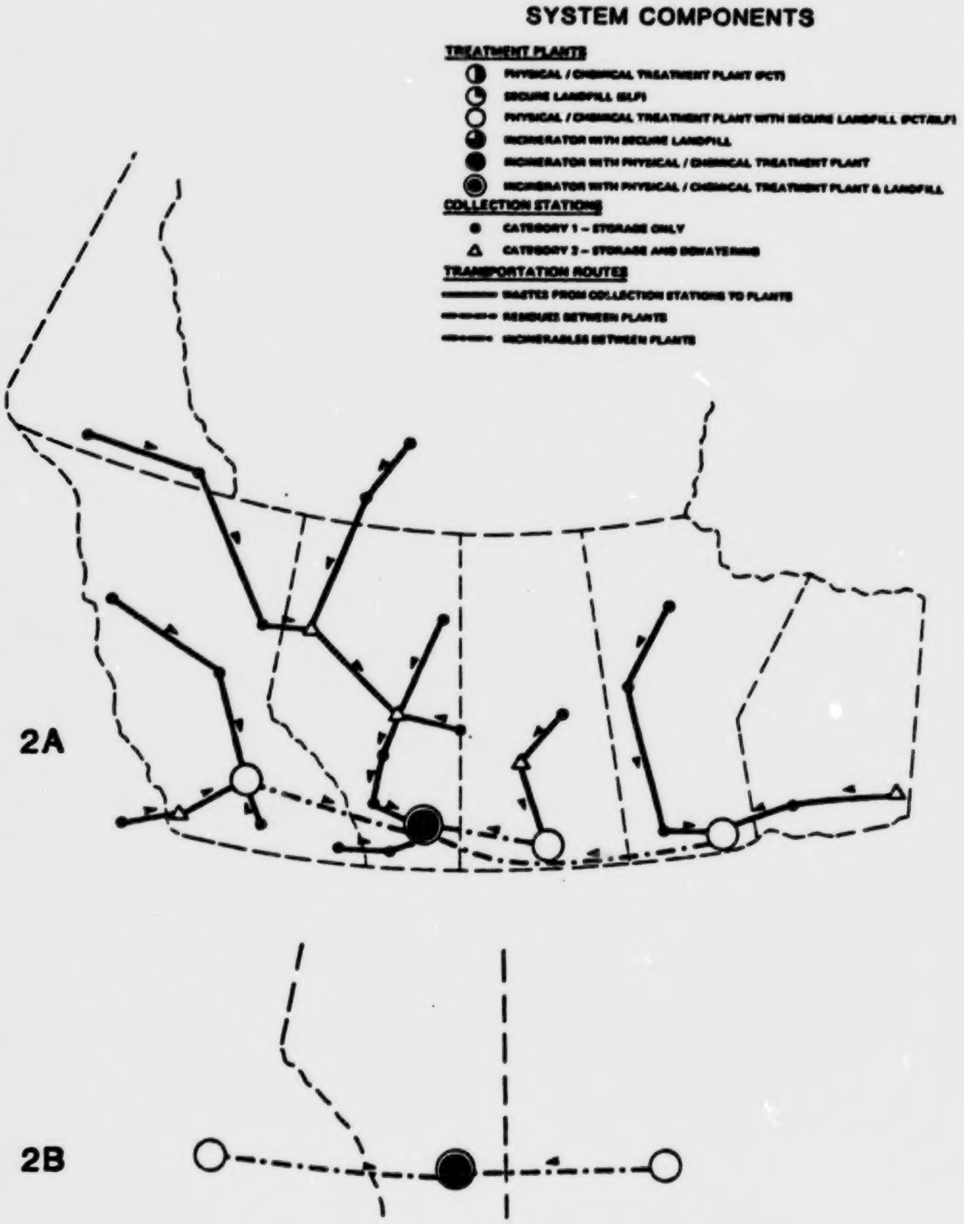
FIGURE 1


SYSTEM COMPONENTS
TREATMENT PLANTS
PHYSICAL / CHEMICAL TREATMENT PLANT (PCT)
SECURE LANDFILL (SLF)
PHYSICAL / CHEMICAL TREATMENT PLANT WITH SECURE LANDFILL (PCT/SLF)
INCINERATOR WITH SECURE LANDFILL
INCINERATOR WITH PHYSICAL / CHEMICAL TREATMENT PLANT
INCINERATOR WITH PHYSICAL / CHEMICAL TREATMENT PLANT & LANDFILL
COLLECTION STATIONS
CATEGORY 1 – STORAGE ONLY
CATEGORY 2 – STORAGE AND DEWATERING
TRANSPORTATION ROUTES
WASTES FROM COLLECTION STATIONS TO PLANTS
RESIDUES BETWEEN PLANTS
INCINERABLES BETWEEN PLANTS
1A
1B
1C

SERIES 1 ALTERNATIVES

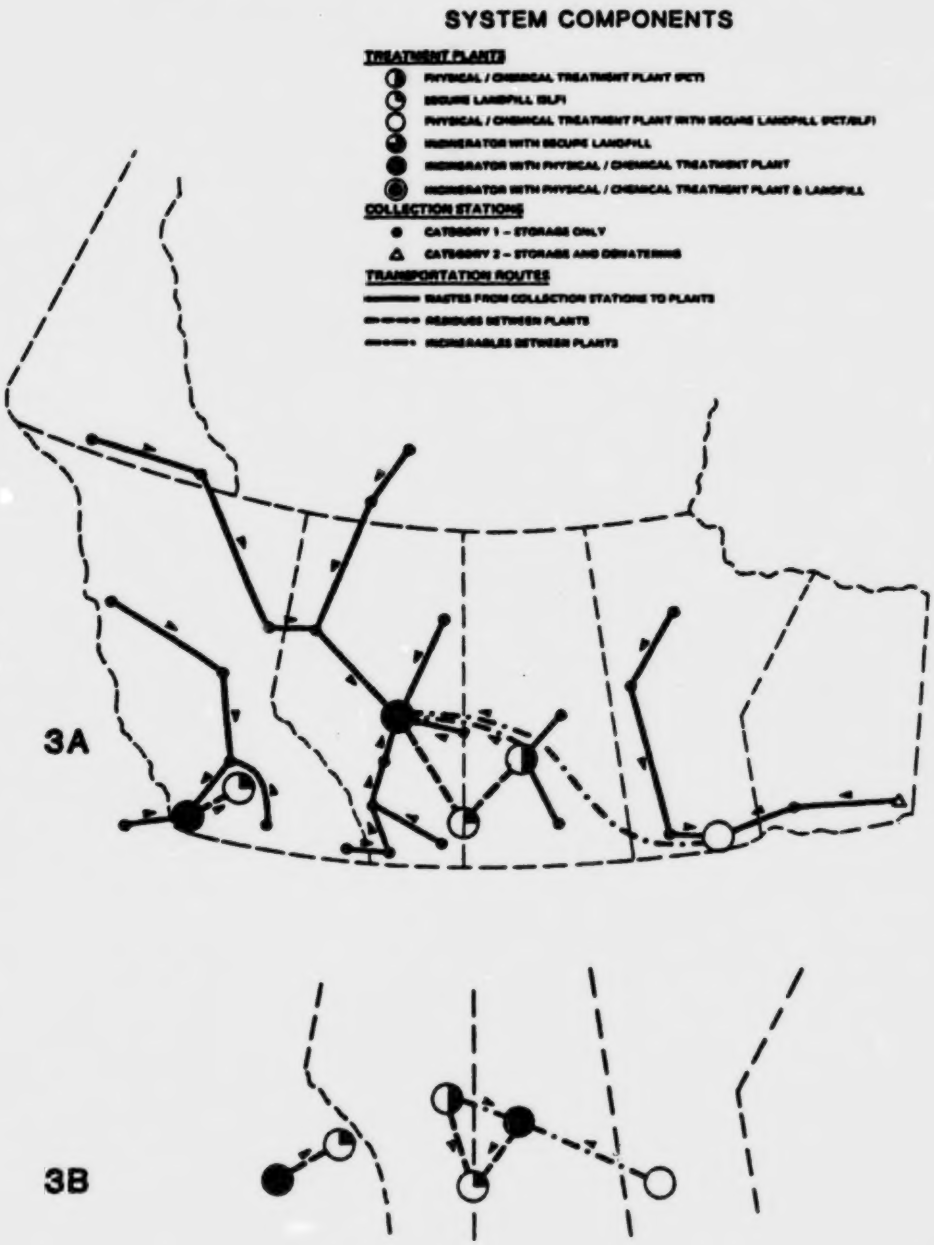
ONE INCINERATOR FOR STUDY AREA

FIGURE 2


SYSTEM COMPONENTS
TREATMENT PLANTS
PHYSICAL / CHEMICAL TREATMENT PLANT (PCT)
SECURE LANDFILL (SLF)
PHYSICAL / CHEMICAL TREATMENT PLANT WITH SECURE LANDFILL (PCT/SLF)
INCINERATOR WITH SECURE LANDFILL
INCINERATOR WITH PHYSICAL / CHEMICAL TREATMENT PLANT
INCINERATOR WITH PHYSICAL / CHEMICAL TREATMENT PLANT & LANDFILL
COLLECTION STATIONS
CATEGORY 1 – STORAGE ONLY
CATEGORY 2 – STORAGE AND DEWATERING
TRANSPORTATION ROUTES
WASTES FROM COLLECTION STATIONS TO PLANTS
RESIDUES BETWEEN PLANTS
INCINERABLES BETWEEN PLANTS
2A
2B

SERIES 2 ALTERNATIVES
ONE INCINERATOR & ALL FACILITIES
IN SOUTHERN ZONE

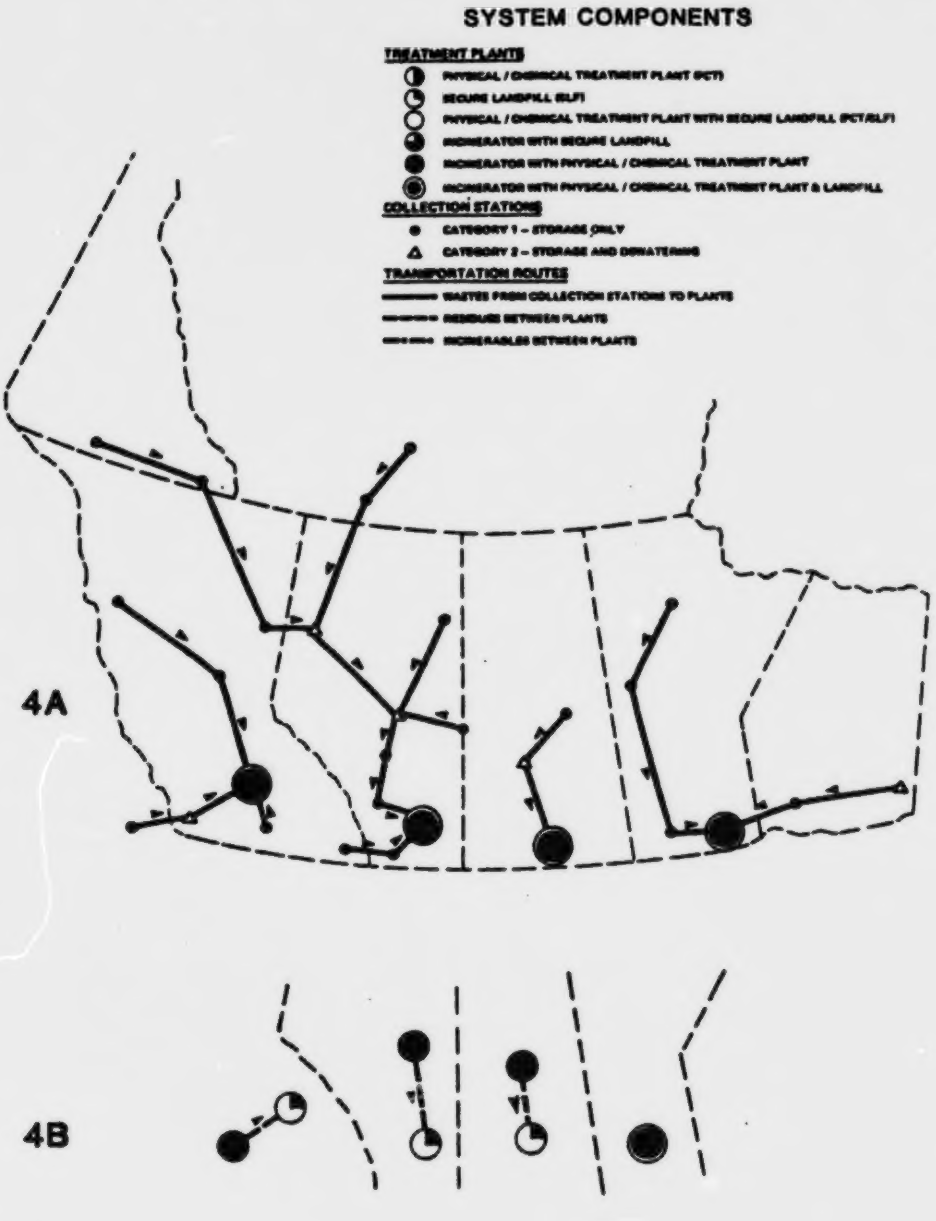
FIGURE 3


SYSTEM COMPONENTS
TREATMENT PLANTS
PHYSICAL / CHEMICAL TREATMENT PLANT (PCT)
SECURE LANDFILL (SLF)
PHYSICAL / CHEMICAL TREATMENT PLANT WITH SECURE LANDFILL (PCT/SLF)
INCINERATOR WITH SECURE LANDFILL
INCINERATOR WITH PHYSICAL / CHEMICAL TREATMENT PLANT
INCINERATOR WITH PHYSICAL / CHEMICAL TREATMENT PLANT & LANDFILL
COLLECTION STATIONS
CATEGORY 1 – STORAGE ONLY
CATEGORY 2 – STORAGE AND DEWATERING
TRANSPORTATION ROUTES
WASTES FROM COLLECTION STATIONS TO PLANTS
RESIDUES BETWEEN PLANTS
INCINERABLES BETWEEN PLANTS
3A
3B

SERIES 3 ALTERNATIVES

TWO INDEPENDENT SYSTEMS

FIGURE 4


SYSTEM COMPONENTS
TREATMENT PLANTS
PHYSICAL / CHEMICAL TREATMENT PLANT (PCT)
SECURE LANDFILL (SLF)
PHYSICAL / CHEMICAL TREATMENT PLANT WITH SECURE LANDFILL (PCT/SLF)
INCINERATOR WITH SECURE LANDFILL
INCINERATOR WITH PHYSICAL / CHEMICAL TREATMENT PLANT
INCINERATOR WITH PHYSICAL / CHEMICAL TREATMENT PLANT & LANDFILL
COLLECTION STATIONS
CATEGORY 1 – STORAGE ONLY
CATEGORY 2 – STORAGE AND DEWATERING
TRANSPORTATION ROUTES
WASTES FROM COLLECTION STATIONS TO PLANTS
RESIDUES BETWEEN PLANTS
INCINERABLES BETWEEN PLANTS
4A
4B

SERIES 4 ALTERNATIVES

FOUR INDEPENDENT SYSTEMS

FIGURE 5

SITE SELECTION

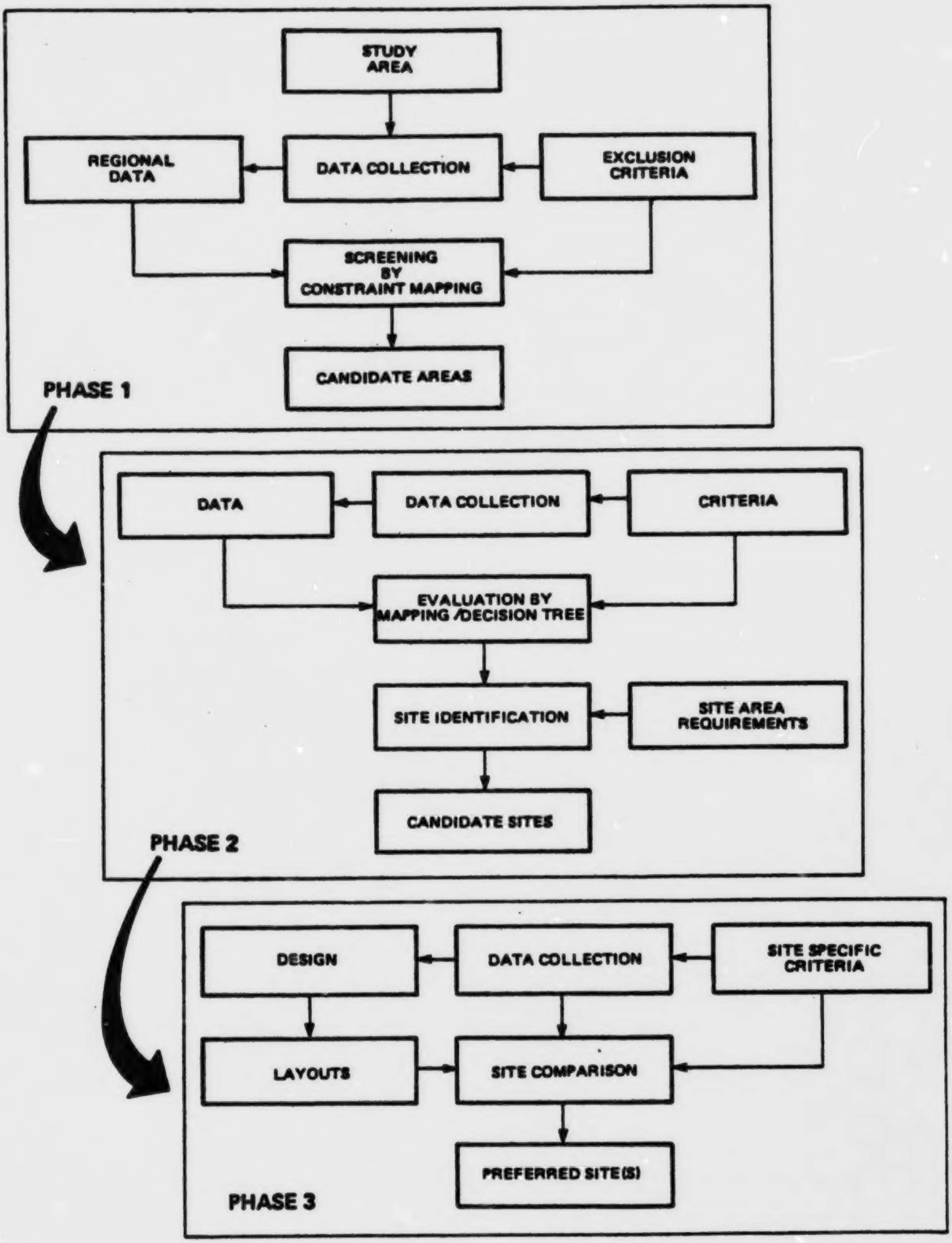


FIGURE 6

IMPLEMENTATION SCHEDULE

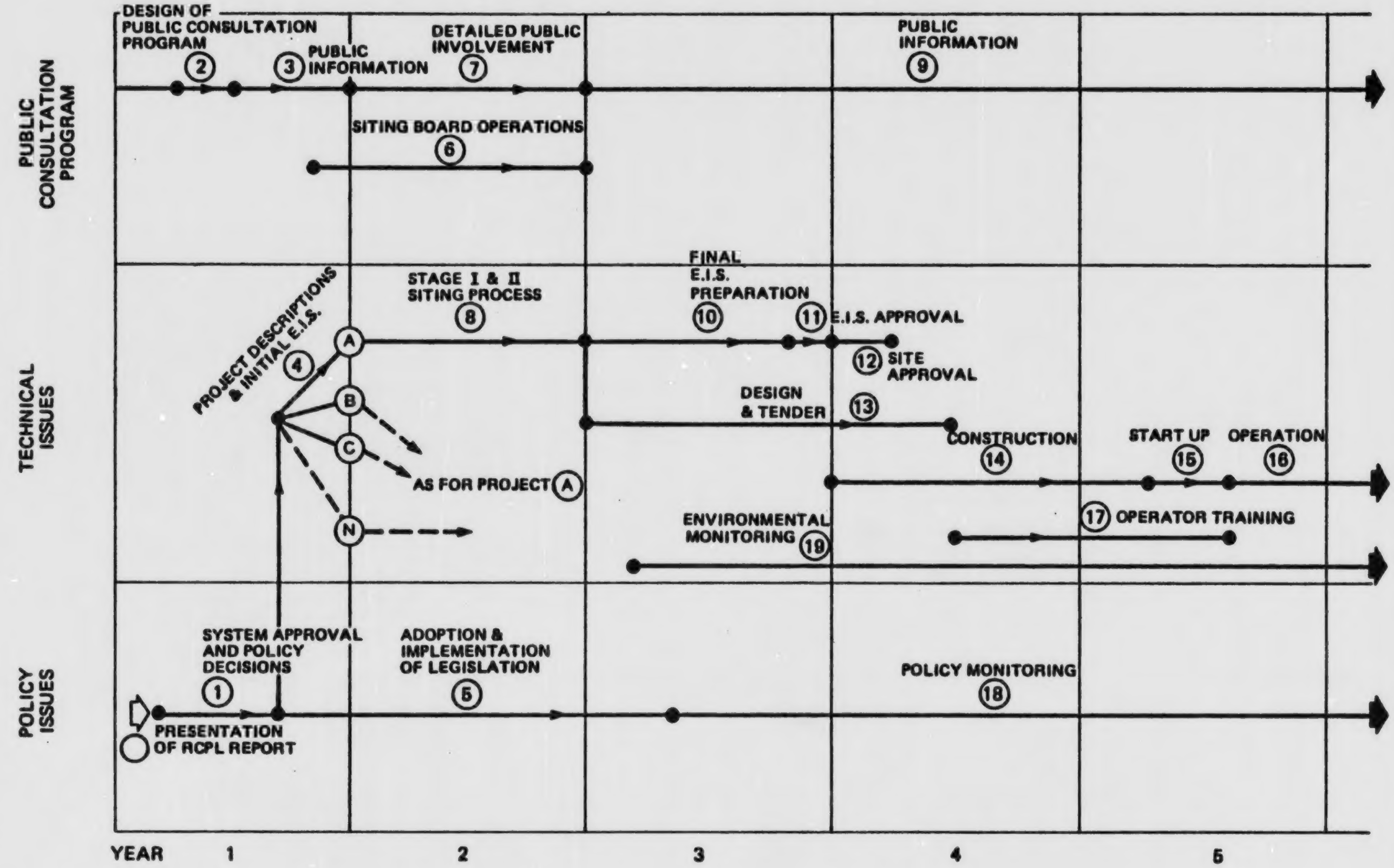

PUBLIC CONSULTATION PROGRAM
TECHNICAL ISSUES
POLICY ISSUES
DESIGN OF PUBLIC CONSULTATION PROGRAM ②
③ PUBLIC INFORMATION
DETAILED PUBLIC INVOLVEMENT ⑦
PUBLIC INFORMATION ⑨
SITING BOARD OPERATIONS ⑥
PROJECT DESCRIPTIONS & INITIAL E.I.S. ④
A
B
C
N
AS FOR PROJECT A
STAGE I & II SITING PROCESS ⑧
FINAL E.I.S. PREPARATION ⑩
⑪ E.I.S. APPROVAL
⑫ SITE APPROVAL
DESIGN & TENDER ⑬
CONSTRUCTION ⑭
START UP ⑮
OPERATION ⑯
⑰ OPERATOR TRAINING
ENVIRONMENTAL MONITORING ⑲
SYSTEM APPROVAL AND POLICY DECISIONS ①
ADOPTION & IMPLEMENTATION OF LEGISLATION ⑤
POLICY MONITORING ⑱
PRESENTATION OF RCPL REPORT
YEAR
1
2
3
4
5

FIGURE 7

CRITERIA EMPLOYED IN
SELECTING CANDIDATE SITES
FOR WASTE MANAGEMENT
FACILITIES FOR THE
ONTARIO GOVERNMENT

By

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1. INTRODUCTION & PURPOSE

Following a review of competitive proposals, Ontario's Ministry of the Environment retained MacLaren Engineers in March 1979 to prepare an overall management plan for handling the Province's liquid industrial and hazardous wastes. In this context, the term liquid industrial and hazardous wastes includes a wide variety of materials which should not be disposed of into sewers or municipal sanitary landfills without some form of pre-treatment. They include oil-water mixtures, spent acid and alkali cleaners, halogenated organics such as banned pesticides and fluids containing PCB's etc. Radioactive materials were excluded from the study.

An important part of this assignment was the identification of candidate areas within which treatment/disposal facilities might be located. The purpose of this presentation is to briefly summarize in chronological order, the studies carried out which eventually led to the Province's decision to attempt to establish a comprehensive waste management complex on the "South Cayuga" lands in the town of Haldimand some 40 km south of Hamilton.

2. STUDY AREA & SELECTION CRITERIA

From an analysis of the data generated by Ontario's Way-Bill system since it's inception in 1977, it was determined that the majority of the liquid industrial and hazardous wastes (generally over 95%) were generated in that portion of the Province bounded by the Great Lakes system on the west and south, the Regional Municipality of Durham on the east and a line joining Orillia with Owen Sound on the north. On this basis, the consultant recommended, and the Province agreed that, (in the initial stages at least), the study area be confined to the region described in the preceding sentence. To establish waste management sites outside this section of the Province would create unique environmental and social risks to districts of the Province which have no interest or need for the service and at considerable additional transportation cost to those requiring the service.

Once the study area was established, the MacLaren team of Engineers Planners & Scientists developed draft siting criteria which were reviewed first by the Ministry of the Environment and subsequently by seventeen public interest groups. After several weeks of discussion, a reasonable consensus was achieved with respect to the suitability of the siting criteria and it was then possible to proceed with an analysis of the study area using a constraint mapping technique as described in the next section.

3. IDENTIFICATION OF CANDIDATE REGIONS

Details of the siting criteria used are contained in Annex II of the MacLaren report (1) and highlights are shown in Table 1. The initial screening may be described as a "broad brush" effort in which "macro criteria" under the catagories of Social/Cultural, Earth Sciences and Hydrology were employed to eliminate sections of the study area from further consideration. As an example, social concerns required the region containing a site opportunity to be more than 8 km from urban areas, and outside of Indian reservations, parks, conservation areas and prime agricultural land.

For earth sciences, as a further example, soil permeability, topography, geology and groundwater conditions were reviewed to set certain minimal criteria and any areas failing to satisfy these criteria was eliminated from consideration on the overlay map of the study area.

TABLE 1 - CRITERIA FOR SELECTING CANDIDATE REGIONS

	Suitability for Siting		
ategory & Factors	Acceptable	Unacceptable	Comments
OCIAL/CULTURAL			
Urban or densely pop. areas		Closer than 8 km to a built-up area	Further from populated area the better the site
Recreational/Conservation areas		Areas designated or established as parks or open space	Condition set as above
Agricultural areas	Avoid Canada land inventory Class 1, 2 lands for certain and classes 1,2,3 & 4 if practical	Use of Class 1 and 2 lands	Class 1 and 2 lands critical
ARTH SCIENCES			
Topographic relief	Slopes 1% to 5%	Extreme flat or hilly terrain	Drainage problems with flat areas and siting problems in hilly areas
Geology	Thick surficial deposits undisturbed sedimentary bedrock low seismic risk	Exposed bedrock highly fractured bedrock higher seismic risk	Maintenance of materials within the treatment area
Soils	Impervious clay/silt/loam materials easily worked, poor agricultural use	Pervious sands or gravels good agricultural land	Low permeability of soils key compenent
Subsoils	Low permeability structurally unstable	High permeability structurally stable	Low permeability key as above
Groundwater	No aquifer recharge at site, deep water table, flow network in area established	Aquifer recharge at site, high water table, erratic or unknown flow network	Groundwater in site area to be protected
YDROLOGY			
Water supplies	Site remote from sources of water supplies	Site near to drinking water source	Drinking water supplies to be protected

cont'd...

TABLE 1 - CRITERIA FOR SELECTING CANDIDATE REGIONS

	Suitability for Siting		
ategory & Factors	Acceptable	Unacceptable	Comments
HYDROLOGY continued			
Major bodies of water or wetlands	Site not adjacent to major body of water to wetland area	Site adjacent to a multi-use water body or wetland area	Protection of water quality in the area
Flooding	Site is above flood prone areas	Site in flood prone areas	Flood protection of site necessary
Drainage	Good site drainage and control	Poor site drainage with no control	Avoid contamination of surface waters by containment of wastes

Surface water considerations such as site flooding potential and promimity to potable water sources produced further criteria to reduce the study area to a reasonable number of regions in which site opportunities could be investigated.

The foregoing "macro screening" of the study area resulted in the identification of 17 Candidate Regions which were considered to have some opportunities for siting waste management facilities. These were then analyzed in greater detail using additional criteria, larger scale mapping, planning studies (mainly from Ministry of Natural Resources), official plans, the most current aerial photography, and a few other miscellaneous secondary sources of information (e.g. zoning bylaws). This exercise reduced the 17 candidate regions to five "assessment areas" which were identified by the name of the district or county in which each was located thus, Lambton, Huron, Bruce, North Simcoe and South Simcoe.

To this point, only secondary sources of information were employed (no field work). Since the five areas selected for final assessment were privately owned, no attempt was made to carry out on-site investigations. However, all areas were visited and viewed from public roadways. In addition, a number of boreholes were hand-augered along the public rights-of-way to confirm surficial soil types.

4. ASSESSMENT AREAS

While processing data collected during site visits to the five "assessment areas", the study team came to realize that none of the areas truly met the spirit and intent of the original criteria established for site selection purposes. For example, certain lands designated as class 5 or 6 on the Canada Land Inventory (CLI) had been significantly up-graded by local drainage work and had become as productive as the adjoining class 2 lands. In other areas, good quality class 1 and 2 lands (according to the CLI classification) had been allowed to deteriorate and become relatively unproductive. In brief, logic dictated that land classification shown on the CLI maps should not be used exclusively to assess agricultural productivity or value because in some instances, they were not a true reflection of the existing conditions. Once this limitation of the CLI maps was fully recognized, it was concluded that the agriculture criteria originally developed should be supplemented with new criteria which permitted the use of relatively less productive lands for waste management purposes in preference to those which were highly productive regardless of their CLI rating.

With these refined agricultural criteria in mind, selection of waste management sites on privately-held land appeared even more difficult and the possibility loomed that all candidate areas might be eliminated. Accordingly, two government-owned areas previously dismissed from consideration, (largely because of their CLI classification), were introduced into the area assessment process at the request of Ministry Officials. South Cayuga and Canadian Forces Base Borden were scrutinized following the same assessment techniques as the five assessment areas which had previously been identified.

It was felt that these two areas (if proven to have environmentally suitable sub-areas) would enable development of a waste treatment/disposal complex to proceed with less disruption to residents and land-use in the surrounding area because of their ownership status and current use. Another advantage of the two Government owned parcels is their proximity to many of the Province's liquid waste generators.

Using the revised agricultural criteria as discussed above, while optimizing all of the other criteria, the Huron area was identified as the most suitable of the five for a waste disposal complex with the Lambton and Bruce areas being the best alternatives and very "close seconds". The two Simcoe areas were ranked very low in comparison to those in Huron, Bruce and Lambton counties.

The primary constraining factor in the Lambton areas (compared to Huron) was land-use conflict with respect to the existing agricultural use and the potential for future residential growth. In the Bruce area, transport distance was the major constraining factor in addition to some minor biological and geological constraints for portions of the area. A few acceptable pockets of land were, however, identified in the Bruce area.

On the basis of the assessment studies carried out for the two government-owned parcels, it was concluded that closer scrutiny was warranted in the case of South Cayuga where lands in the northern half showed potential for siting a waste treatment/disposal complex. In the case of Camp Borden, a number of constraints were identified (e.g. soil type, bological and land use conflicts) making it generally unsuitable for detailed field studies.

In comparison to the non-government held lands, South Cayuga was considered more suitable than the two Simcoe areas and camparable, environmentally, with the Lambton and Bruce areas. It did not appear as one of the original seventeen Candidate Regions because 95% ± of the area carries a Class 2 agricultural designation on the CLI maps with the balance being a mixture of class 1 and 3. Huron is preferable to South Cayuga environmentally because of the latter's proximity to the Grand River. However, South Cayuga is more centrally located to the areas of waste generation than is Huron.

5. TRANSPORTATION ANALYSIS

A transportation analysis using accident data obtained from the MTC and a program developed by the Consultant showed that vehicles hauling liquid industrial wastes are likely to be involved in very few accidents in any given year (1 or 2 accidents per year as compared with the annual Provincial total of over 180,000). This very low accident frequency makes it difficult to justify one area over another on the basis of transportation risk considerations. However, on the basis of transportation costs, (as measured by the lowest total miles needed to haul wastes to a given site), the South Cayuga area scored most favourably followed by Huron and Lambton, thus:

Site	Total Annual Travel to Deliver All Wastes to Site Named
S. Cayuga	3 114 000 km
Huron	3 947 000 km
Lambton	4 054 400 km
Borden	4 678 800 km

6. CONCLUDING COMMENTS

After carefully considering all of the foregoing factors, the Ministry of the Environment selected the Provincially-owned South Cayuga lands for further study as a possible site for a central waste treatment/disposal complex. Hydrogeological studies are now underway to establish whether or not the selected site is suitable for the development of a secure landfill. The Province has also established a Crown Agency known as the Ontario Waste Management Corporation (OWMC) with a mandate to establish a complex on the South Cayuga lands if they are deemed suitable by the hydrogeologists.

In the event that the hydrogeologists recommend against development of the South Cayuga lands, the Corporation is charged with the task of locating an alternative site.

Under the terms of Bill 90, "An Act To Establish The Ontario Waste Management Corporation", the Corporation is responsible to the Lieutenant Governor In Council and reports through a member of the Executive Council to the Lieutenant Governor In Council. The member through whom the Corporation reports may or may not be the Minister of the Environment. It is important to recognize that under Ontario laws, a Crown Agency (such as the OWMC) is immune and unaffected by local municipal bylaws which are designed to outlaw waste management facilities.

The Province has also appointed a three-person panel or tribunal to conduct public hearings and determine the technological suitability of the South Cayuga lands for waste management facilities. Two preliminary hearings have been conducted to date (one on 28 May and one in July) in which area residents were invited to make their concerns known relative to the proposed facilities. Formal hearings in which the proponent makes his plans known are scheduled for the autumn of 1981.

REFERENCES

1. Report To The Ministry Of The Environment On The Siting Of Facilities & The Management Of Liquid Industrial & Hazardous Wastes In Ontario - November 1980 by MacLaren Engineers Planners & Scientists Inc.

PUBLIC INTEREST GROUPS WITH WHOM SITING CRITERIA WERE REVIEWED

Association of Counties and Regions of Ontario
Association of Municipalities of Ontario
Canadian Environmental Law Association
Canadian Manufacturers Association
Conservation Council of Ontario
Federation of Ontario Naturalists
Liberal Party of Ontario Research Division
New Democratic Party Research Division
Ontario Chambers of Commerce
Ontario Federation of Agriculture
Ontario Federation of Labour
Ontario Liquid Waste Haulers Association
Ontario Trucking Association
Pollution Probe
Rural Ontario Municipal Association
Sierra Club
Lyn McMillian (as representative for citizens opposing the Maple Sanitary Landfill)

HAMILTON /
WENTWORTH

HAMILTON-WENTWORTH

SOLID WASTE MANAGEMENT SYSTEM

Presented for:

Environment Canada
3rd Annual Conference on
Waste Management in Canada
Planning of Facilities
Toronto, Ontario
Oct. 14-16, 1981

Presented by:

Romeo F. Palombella, P. Eng.
Waste Management Systems Engineer
Department of Engineering
Region of Hamilton-Wentworth

Outline: Hamilton-Wentworth Solid Waste Management System

A film describing the Region of Hamilton-Wentworth solid waste management system, entitled "Meeting The Challenge", is the main focus of this presentation. This film was commissioned jointly in 1980 by the Region of Hamilton-Wentworth; Tricil Ltd., the Region's waste management contractor; Proctor and Redfern Ltd., the Region's waste management consulting firm; the Ontario Ministry of the Environment; and Environment Canada. The script and production were developed by the local Hamilton firm of Aquila Film Productions.

The film presentation will be accompanied by a printed summary review of the Region's solid waste management system. The film and paper describe the studies and planning processes initiated in 1972, leading to the development of the new disposal system in 1980. System components, including:

- SWARU (Solid Waste Reduction Unit), a waste-to-energy municipal incinerator
- three transfer stations
- compacted bulk haulage
- a modern 550 acre landfill site

are described.
Existing and proposed programmes related to energy and resource recovery are touched upon.

Overall implementation costs are also detailed in the paper.

This presentation will be of interest to municipalities or disposal site contractors who may be planning to develop new waste disposal or processing facilities within the next five (5) to ten (10) years.

THE HAMILTON-WENTWORTH SOLID WASTE MANAGEMENT SYSTEM

"MEETING THE CHALLENGE"

1. EVOLUTION OF THE SYSTEM

The problem of disposal of solid wastes in the Hamilton-Wentworth area was first recognized in the early 1960's. At that time, and after considerable investigation and review, the City of Hamilton decided to proceed with the construction of an incinerator with metal and energy recovery capabilities, now known as SWARU (Solid Waste Reduction Unit). This facility was completed in 1972.

In 1971 the Waste Management Branch of the Ontario Department of Energy and Resource Management, the County of Wentworth, and the City of Hamilton, decided to proceed with a study of the disposal of solid wastes in the area. Proctor and Redfern, consulting engineers and planners, were retained to complete this study.

Four initial reports were completed by Proctor and Redfern, prior to the establishment of Regional Government in the Hamilton-Wentworth area in 1974.

Following the formation of the Regional Municipality of Hamilton-Wentworth on January 1st, 1974, Proctor and Redfern was retained by the Region to continue work on the development of a solid waste management system for the Region. Two interim reports were then prepared.

After completion of the Interim Reports, public meetings were held in the Area Municipalities of Glanbrook and the Town of Ancaster. The recommendations contained in previous reports were outlined in detail at these meetings and the public was asked to respond to the concept.

Two additional reports pertaining to public input and the hydrogeological aspects of proposed sites were prepared.

2. DEVELOPMENT OF THE WASTE MANAGEMENT CONTRACT

In September, 1976, Regional Council called for tenders on a waste management system. Tenders closed on February 25th, 1977.

The tender documents did not limit Contractors to a specific system. They were asked to submit proposals/tenders on any system they wished to offer. Tentative locations for a landfill site and transfer stations were indicated, but contractors were free to include any other sites they wished to propose, and could either include or exclude the operation of SWARU in their proposal.

An initial review of the tenders indicated that no alternate sites had been suggested and that all proponents required a landfill site. On March 7th, 1977, Regional Council authorized the acquisition of the proposed landfill site in the Area Municipality of Glanbrook and also authorized the initiation of changes to the official plan and zoning by-laws for the proposed landfill site and transfer stations.

A Steering Committee was established by Regional Council to review the tenders. As part of this review process, members of the Steering

Committee visited a number of municipalities throughout North America operating similar facilities to those offered by the proponents. The Steering Committee then prepared three reports regarding tender evaluation and final recommendations.

These reports recommended to Regional Council that a detailed agreement be negotiated with Tricil Limited for:

- the modification and operation of SWARU;
- the construction of three transfer stations;
- the transfer of the waste to a sanitary landfill site in Glanbrook;
- and the operation of the landfill site.

Negotiations were successfully concluded and an agreement signed by the Region and Tricil on October 5th, 1977.

3. THE SYSTEM

The waste management system which has evolved includes:

(a) A COLLECTION SYSTEM which is required to gather the solid waste at home or business establishment and deliver it to transfer stations. This collection system is not the responsibility of the Region. It is the responsibility of Area Municipalities and private enterprise.

(b) TRANSFER STATIONS strategically located at Olympic Drive in Dundas, at Upper Ottawa Street and at Kenora Avenue in Hamilton. These are depots for receiving and shipping waste. Here waste is compacted into large completely enclosed transfer trucks and hauled to the landfill site. The transfer stations provide a means of traffic control, permit improved regulation of the types of waste accepted, and provide an economical point of discharge for the collection agencies. Ultimately, the transfer stations can be adapted to front-end processing facilities in a comprehensive resource recovery system. The transfer stations began operations in July, 1980.

(c) The SOLID WASTE REDUCTION UNIT (SWARU) which incinerates waste to generate steam and also recovers metal. This reduces the volume of material that requires landfilling. Tricil has entered into a Joint Venture Agreement with the Ontario Energy Corporation to generate electricity at SWARU for sale to Ontario Hydro. This project, the first of its kind in Canada, will utilize a four megawatt (nominal capacity) steam turbine generator which will be operational by July, 1982.

(d) A HAULAGE SYSTEM which consists of 75 cubic yard transfer trailer vehicles, hauling totally enclosed compacted waste along prescribed routes on major roadways from the transfer stations to the landfill site. The transfer units are the only vehicles delivering waste to the landfill. Traffic impact is minimized and use of the landfill site is optimised. The Region's municipalities also benefit as a result of reduced haulage distances.

(e) A SANITARY LANDFILL in the Area Municipality of Glanbrook where waste is compacted and buried in earth covered cells. This site is designed and operated in accordance with the latest standards of the Ministry of the Environment. A continuous and comprehensive environmental monitoring programme is in effect for this facility which commenced operation in October, 1980.

4. IMPLEMENTATION OF THE SYSTEM

The proposed land use at the transfer stations and at the landfill site has to conform to the Official Plans and Zoning By-laws of the Area Municipalities.

Changes were initiated to the Official Plan, Zoning By-law and Parkway Belt West for the Dundas transfer station and to the Zoning By-law for the mountain transfer station. No changes were required for the Kenora transfer station.

The changes to the Official Plan and Zoning By-law of the Area Municipality of Glanbrook to permit the establishment of the landfill site, the Tricil agreement, and the financing of the project were the subject of a lengthy Ontario Municipal Board Hearing.

Following final approval from the Ontario Municipal Board, application was then made to the Ministry of the Environment for approval of the proposed landfill site. This application was the subject of a lengthy hearing before the Environmental Assessment Board. A favourable recommendation was received from the Board and final approval was received from the Ministry of the Environment in December 1979.

As soon as all necessary approvals were received, work started on the detailed design and construction of the system.

Tricil completed the modifications to SWARU and have been operating the facility since February 1978. SWARU is operating successfully, and dependably processes one-third of the Region's solid waste stream.

The former landfill sites which were inherited by the Region from the area municipalities were closed to the public in 1980, and have received final cover and grading measures in 1981. It is anticipated that ownership of the closed sites will be returned to the appropriate area municipalities. The Region will continue to perform ongoing environmental monitoring at these sites, in accordance with Ministry of the Environment guidelines.

5. CAPACITY OF THE SYSTEM

The nominal capacity of the waste management system is 600 000 tons per year.

SWARU has been modified and now has a guaranteed capacity of 120 000 tons per year.

The installed capacities of the transfer stations are as follows:

Dundas		130 000 tons/year
Mountain		130 000 tons/year
Kenora		350 000 tons/year
	TOTAL	610 000 tons/year

The capacities at the Mountain and Kenora stations can be easily increased by adding additional compactors.

If SWARU is closed for modifications or repairs, the wastes normally delivered to that facility will be delivered to the Kenora Transfer Station. This transfer station has sufficient excess capacity for this purpose.

6. COST OF THE SYSTEM

The total capital cost of the system, excluding SWARU, but including land acquisition, construction of the transfer stations, preparation of the landfill site and the cost of all hearings and consultants fee was $11 398 000. The annual gross operating cost of the system is $9 500 000, which is partially off-set by tipping fees.

The estimated annual cost per household for the disposal of solid waste is $35.

The tipping fees at the transfer stations is $1.50 per 100 kilograms, or $14.60 per ton.

7. SIGNIFICANT FEATURES OF THE SYSTEM

The overall system is a major step forward in the disposal of solid waste and makes the Hamilton-Wentworth Region one of the forerunners in this field in North America.

The upgrading of SWARU has substantially reduced the volume of waste to be landfilled and has provided an opportunity for the recovery and use of the metal and the steam generated in the process.

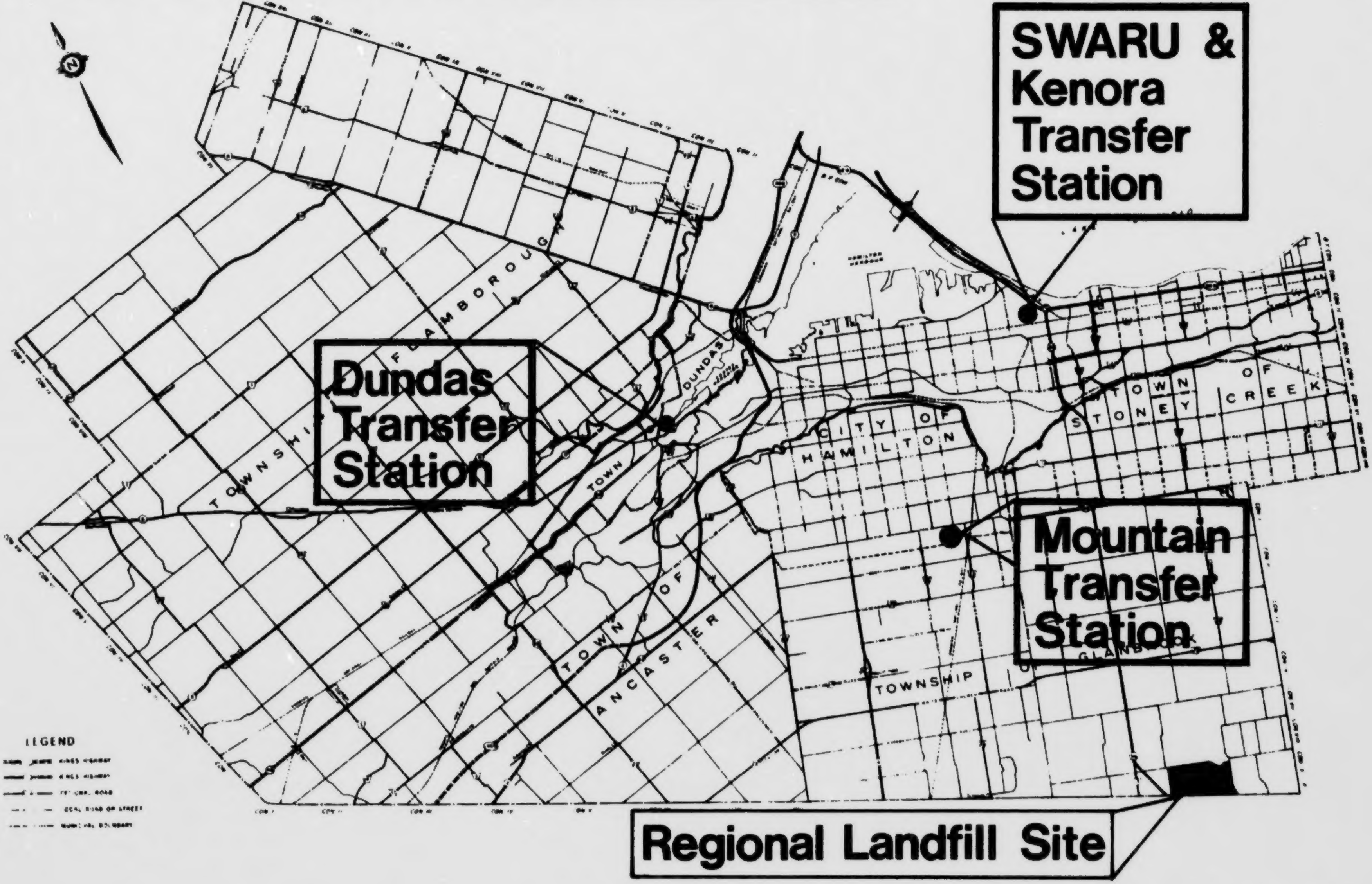
The transfer stations will provide convenient aesthetic locations for the Area Municipalities, private haulers and the public to deposit their wastes. The use of transfer vehicles only to haul the waste to the landfill site will minimize the traffic impact at the landfill site and will make it easier to operate and control the site in an environmentally acceptable manner.

The design of the transfer stations is such that it can easily be modified to include the installation of future resource recovery facilities when they become economically viable.

The unique blending in a major waste management system of government control and private enterprise operation has resulted in an efficient and effective method of waste disposal which can be readily adapted to future advances in resource recovery.

The Regional Municipality Of Hamilton-Wentworth
Department Of Engineering

SOLID WASTE DISPOSAL FACILITIES



FINANCIAL FACTS

SOLID WASTE MANAGEMENT SYSTEM

CAPITAL COSTS (1980)

EXPENDITURES:

Transfer Stations

Land Acquisition	$ 927 301	
Construction	$6 040 839	
Weigh Scales	$ 473 332	
Auxiliary Services	$ 699 027	$ 8 140 499

Glanbrook Landfill Site

Land Acquisition	$1 344 318	
Environmental Studies, Hearings & Negotiations	$ 786 375	
Site Development	$ 369 376	
Site Building	$ 412 667	
Landscaping	$ 207 575	
Auxiliary Services	$ 76 925	
Local Improvement	$ 60 000	$ 3 257 106
TOTAL CAPITAL COSTS:		$11 397 605

FINANCIAL FACTS

WASTE MANAGEMENT SYSTEMS

ANNUAL OPERATING COST (1981)

EXPENDITURES:

Contractual Services - Tricil	$6 360 000	
Other	$ 312 500	
TOTAL OPERATING EXPENDITURES:		$6 672 500
Deduct: Disposal Fees (approximate)		$2 000 000
NET AMOUNT TO BE MET BY GENERAL LEVY:		$4 672 500

NOTES: 1) Solid Waste Fees - $1.50 per 100 kilograms

2) Estimated Residential Realty Taxes for Waste Disposal for property valued at $50 000 is approximately $35 per household.

October 15th - 1:30 - 3:30 p.m.

After Use of Facilities

Moderator:	Bob Ferguson Dept. of Works Metro Toronto
Panelists:	Micheal Hanchak CECOS International Niagara Falls, New York (closure procedure)
	Lawrence Kryviak Alberta Environment Edmonton, Alberta (dump closure)
	Ed Gilman Bartlett Tree Labs Pineville, North Carolina (landfill revegetation)
	Alan Shuckrow Touhill, Shuckrow and Associates Pittsburgh, Pennsylvania (hazardous waste leachate collection and treatment)

Third National Conference On
Waste Management In Canada

AN OVERVIEW TO THE RECLAMATION OF ABANDONED DUMPS IN ALBERTA

Lawrence M. Kryviak, P. Geol.
Head Reclamation Branch
Alberta Environment

ABSTRACT

With the implementation of Regional Sanitary Landfills throughout the Province; garbage dumps which served Towns, Villages and Local Rural populations are being abandoned. Through the Heritage Savings Trust Fund Land Reclamation Program, the Reclamation Branch of Alberta Environment has undertaken to reclaim these and other abandoned dumps.

Reclamation of these dumps is however not without problems. This paper will attempt to give you some insight on the problems involved in reclaiming these sites, show you how these problems are handled, and to also try and show you the success we have had.

INTRODUCTION

In late 1973, the Alberta land reclamation program was born. By using a system of written invitation with qualifying criteria, Towns, Villages, and other Municipal Governments are invited to participate in the Heritage Savings Trust Fund Reclamation Program to have derelict lands reclaimed; with abandoned garbage dumps being prime qualifiers for reclamation.

After an application for reclamation of a garbage dump is received and assessed by the Reclamation Branch, planning and scheduling for the reclamation of the dump begins. While planning for the reclamation of abandoned dump sites the main objectives in mind are to:

1. Eliminate or minimize a health and safety hazard.

2. Secure a stable vegetative cover on the abandoned site to prevent wind and water erosion and to prevent the growth of noxious weeds.

3. Improve the aesthetic appearance of the area.

4. Bring the reclaimed area back to productive use if at all feasible.

While undertaking to reclaim abandoned dumps with the preceding four objectives in mind, many problems are encountered due to the fact that the location of old dumps were usually out-of-the-way areas, land areas which had no forseeable beneficial use to whomever chose the site for dumping.

These locations usually include:

1. Low wet areas - areas which obviously make working conditions with heavy equipment very difficult, thus the timing of reclamation work at these sites becomes a critical factor.

2. Coulees - which are steep and inaccessible are a very popular choice as dump sites in southern Alberta. It appears the steep long slopes make for excellent dumping and the dump requires minimal maintenance during its active life, but poses problems for working with heavy equipment. Seeding and soil erosion problems also occur due to the long steep slopes associated with Coulee Dumps.

3. River and creek banks - seem to be another choice location for dumps. While being a prime site for dumping (steep long slopes make for easy dumping and no maintenance) They are one of the most difficult when reclaiming. As with coulees these areas are usually very steep and inaccessible, and another added problem of potential water pollution is also present.

4. Expired gravel pits - do not present any major problems for reclamation work by heavy equipment. However suitable capping material (clay and loam to provide a growing media plus being a suitable material to prevent water infiltration through the garbage and into the watertable) is usually in very short supply.

5. Abandoned coal mines - both strip mines and underground mines have been used as dumps in the past. The problems involved with the reclamation of these sites are the extreme danger involved with backfilling water filled holes and not knowing what unexpected problems could come up.

Two other problems other than the location of a dump are: The manner of waste disposal and the nature of material disposed of in the dump. Even in areas where there are no water problems, soil problems, or location problems to contend with, the major obstacle to successful reclamation is the manner in which the material was disposed of. If trenches were used and were not constructed in an orderly manner, trying to bury and dispose of the remaining surface garbage can become quite a time consuming and expensive operation when locating clean areas for excavation.

The make-up of the garbage dumped may cause disposal problems. For instance car bodies are very bulky and use up a lot of room when reclaiming a dump.

Construction procedures vary with the different types of problems involved when reclaiming abandoned dumps.

For low wet areas timing is crucial for certain periods of the year or in certain years the areas may dry up sufficiently well enough to excavate proper trenches to bury and compact the garbage and recontour the site with conventional heavy equipment. If, however the area does not dry sufficiently for conventional heavy equipment, specialized equipment such as L.G.P. tractors or bulldozers with rice paddy tracks are employed.

Coulees and river banks are usually steep slope problems during both construction and revegetation of the site. The main technique to cope with this problem is to extend the slopes to prevent slumping and minimize erosion and to hydroseed the site to establish a quick vegetative cover.

Other common problems associated with the reclamation of dumps are the presence of discarded automobiles. If only two or three are present on a site they are crushed with the heavy equipment and buried in excavated trenches. However, if they are too numerous to dispose of in this manner arrangements are made to have the discarded bodies stockpiled and removed for recycling.

Leachate is another problem in some abandoned dumps. In situations where small amounts are present the leachate is squeezed during reclamation and retained on site. In other instances the leachate has to be pumped out of the abandoned trench or trenches with a vacuum truck and spread over the entire dump area. In severe cases where leachate is present in large quantities, holding ponds are constructed to contain the leachate on site and then the leachate is allowed to evaporate. The salt residue is then worked into the soil with conventional farm equipment and the site revegetated.

In several instances where garbage dumps have been filled to over capacity, adjacent lands have to be obtained in order to properly trench and bury the garbage to achieve an acceptable standard of reclamation.

In extreme cases where Towns and Villages have experienced population booms and their abandoned dumps are surrounded by residential development, the solution to reclamation is the re-excavation of the entire dump and disposal of the garbage at an alternate site according to present day sanitary landfill disposal practises.

To protect the populace at large and to ensure that what the Department of Environment is doing is safe and acceptable, restrictions for the future use of the reclaimed site are placed on the parcels of land in question.

Precautions are also taken by the Department in the form of testing and monitoring of ground water contamination and migration and the monitoring of methane generation on selected sites, were due to location and other conditions future problems can probably be expected.

CONCLUSION

The program which is being sponsored by the Heritage Savings Trust Fund is very popular with the municipalities. To date 171 individual sites have been reclaimed at a total cost of approximately $1,200,000. Individual costs can range from as little as $800 to $1,000 per acre to a high of $12,000 to $16,000 per acre depending upon the location of the dump and other related problems which may occur in any one site.

DEVELOPING PARKS, GOLF COURSES AND OTHER RECREATION AREAS ON COMPLETED LANDFILLS

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Franklin B. Flower. Department of Environmental Science, Cook College, Rutgers University, New Brunswick, New Jersey.

Ida A. Leone. Department of Plant Pathology, Cook College, Rutgers University, New Brunswick, New Jersey.

INTRODUCTION

As urban population continues to grow and landfills are closed, we can anticipate greater stimuli for converting former landfill sites into recreational areas. Communities may be persuaded to turn these former unused wastelands into parks, golf courses and nature centers. The advantages of converting former landfill sites into attractive recreational areas are (a) inexpensive land acquisition, (b) proximity to urban centers, (c) landfills can accommodate rolling landscapes which are frequently desirable for parks and golf courses, (d) value of land will increase after reclamation and (e) could provide a local recreational hunting ground.

The list of disadvantages for converting former landfills into parks is long. Frequently (a) soil cover is thin, (b) cover soil is compacted by the soil spreading equipment causing severe restriction of root growth, (c) soil nutrients and soil moisture levels are quite low, (d) irrigation requirements are greater on landfill areas than on nonlandfill areas, (e) surface irrigation is difficult because of uneven refuse settlement, (f) settlement causes breakage of permanent irrigation and other underground service lines, (g) settlement will cause undulating fairways and greens on golf courses, (h) landfill gases may migrate into soil cover and kill plants, (i) soil oxygen may be forced out of the soil atmosphere by landfill gases and asphyxiate roots, (j) several heavy metals become more available to plants under anaerobic soil conditions and this can lead to poor plant growth and (k) trees (plants) tend to produce shallower roots (1).

Despite the apparent difficulties encountered in vegetating completed landfills, they have been overcome in a few instances within the United States. At these sites, those charged with designing and maintaining the vegetation project were aware of several of the obstacles. However, the majority of reclamation programs were designed by individuals who were unaware of the special problems associated with growing plants on completed dump sites.

This paper will provide guidelines for planting trees and shrubs on a completed landfill. Most recommendations are based on the results of a six-year research grant funded by the Municipal Environmental Research Laboratory of the USEPA. A more comprehensive detailed manuscript is being developed for publication by the Environmental Protection Agency and should be available from EPA in Cincinnati or NTIS by the spring of 1982.

GAS GENERATION

The gases of anaerobic decomposition (primarily methane-CH_4 and carbon dioxide-CO_2) may migrate from the refuse layers into the cover soil and/or into adjacent property (1, 2). Gas contamination of the cover soil will not be uniform over the entire landfill site. Some areas will contain relatively high carbon dioxide ($>25\%$) and methane ($>40\%$) concentration (consequently low oxygen (2%) content); whereas, other areas will be influenced very little by the underlying refuse material. These gases are best controlled by specific activities which should take place soon after the final layer of refuse is spread. It may be best to allow refuse to settle awhile before control measures are installed.

GAS BARRIERS

There is no doubt that combustible gases must be kept from the root system in order for vegetation to survive (2). The provisions which will ultimately lead to a desirable root gas environment are likely to function best and cost less if they are installed prior to spreading the final cover material. These precautions should consist of the selection of a barrier material which is both relatively gas-impermeable, flexible and durable (should last for decades and withstand settlement). This gas barrier material should be placed over the final layer of refuse. This should keep much of the gas away from the cover soil which will be placed over the barrier.

If the gas is prevented from traveling vertically into the cover soil, it is likely to move laterally into adjacent properties. In this case, gas migration control measures should be installed around the periphery of the refuse fill. There is a variety of systems currently available (3).

Impervious liners used to control gas flow include plastic, rubber or similar synthetic membrane, natural clay and asphalt. Polyvinylchloride (PVC) has been the most widely used synthetic membrane, because it can control gases, has a high resistance to deterioration and is relatively inexpensive However, PVC will reportedly lose its plasticizer (and perhaps its effectiveness) after a few decades. Hypalon ^{R}, chlorinated polyethylene (CPE) and other membranes are more attractive where the synthetic material must maintain its performance standard for fifty-plus years. Natural soil barriers, such as water saturated clay or bentinite lagoon liners, may be highly efficient if kept saturated, otherwise cracks develop in surface cover as the refuse settles. Dry clay or bentinite is not an effective barrier.

There are two approaches to installing barriers. One is to cover the entire landfill with the material and the other is to place the barrier only in areas where deeper rooted vegetation (trees and shrubs) will be planted. Also, settlement is likely to cause cracks or breaks in the seals used in either of these approaches allowing gas to penetrate the cover soil.

An alternate method of gas exclusion may consist of the mounding of soil in specific areas where deeper rooted vegetation is to be planted. The mound may be underlain by a clay layer or a membrane at least 20 mil thick. At least 90 cm of soil should be spread over the barrier in areas where trees will be planted.

LOCATING AREAS UNSUITED FOR VEGETATION

One or more years prior to the time when trees are to be planted, a ground cover should be seeded first to provide protection against erosion as well as to indicate where it would not be advisable to plant deep-rooted plants. Suggested annuals for the eastern United States include weeping lovegrass and annual rye grass. These should be seeded with perennials such as tall fescue, birdsfot trefoil or crown vetch. The ideal time for hydroseeding such disturbed areas is in the early spring or fall. In most cases, if the grass cover with its shallow roots dies or fails to germinate because of the influx of gases from the landfill, one can be certain that other deeper-rooted vegetation will not thrive either at these locations.

The easiest and quickest method of locating areas which are unsuited for plant growth is to observe existing vegetation patterns. The carbon dioxide (CO_2) and CH_4 concentrations are likely to be high and limiting to plant establishment in areas where the soil appears thin or the refuse is exposed. As a general rule, one should avoid planting trees and shrubs in areas which are devoid of ground cover.

Poor soil conditions for tree growth may be encountered even in places where grasses and other ground covers are thriving. Anaerobic soil or soil high in CO_2 or low in O_2 concentration may be present in the tree root zone which usually extends below the root zone of grasses. Table 1 points out several differences between aerobic soil which is likely to support tree growth and anaerobic soil. Even though an area has been chosen based on the above criteria for a planting location, differential settlement and varying gas production rates may cause gases to channel into a portion of the cover soil previously uncontaminated and kill existing plant material.

Table I. Guide for Evaluation of Landfill Soil Gas Problem

Characteristic	Anaerobic soil	Aerobic healthy soil
odor	septic	pleasant
color	darker	lighter
moisture content	higher	lower
friability	poor	good
temperature	higher	lower

Refuse and soil settlement, caused by loss of refuse material through decomposition, will create an undulating surface causing water to pond in low spots during rainy and/or irrigation periods. Vegetation in flooded areas may eventually die if water remains for extended periods; whereas, plants on the unsettled higher areas may suffer from drought. Excessively undulating greens will not be tolerated in most golf courses and therefore, provisions such as installing concrete slabs beneath each green should be made to compensate for settlement.

COVER SOIL

Depth

Numerous investigators (4, 5, 6) report that 60-80% of tree root-volume can be found in the top 20 cm of mineral soil. The remaining portion is located at varying depths (from 30-90 cm+) depending on species and soil characteristics. Although a 30 cm landfill cover soil may accommodate a good portion of the root volume, it would dry out quickly during seasonal dry spells. Because of the excessive cost of covering the entire landfill with deep rich soil, one should consider spreading 90 cm only in those areas where trees are to be planted. This need not be composed entirely of topsoil, however; topsoil should be incorporated into the top 20 cm since this is where most of the feeder roots will be growing. At least 60 cm should be spread in areas where trees will not be planted since this complies with Federal and State regulations.

Texture

The texture of cover material will necessarily vary depending on availability. Generally, if no gas barrier has been installed, it is best to first spread soil with a high clay content and cover with a highly organic soil. The deepest organic soil should be placed in areas where trees will be situated, such as a parking lot island, a clump planting on a golf course, or any other group planting. Where a membrane gas barrier has been installed, sand should first be spread on top of the barrier followed by a loamy textured soil capable of supporting plant growth. The sand will serve as a drain so that water will not accumulate above the membrane and roots growing in this region. The sand also asphyxiate serves as a protective buffer between the tires or tracks of soil spreading equipment and the membrane.

Spreading

One should strive for a soil bulk density of 1.2 to 1.4 g/cc in a loam soil. A higher density can generally be tolerated in a coarser soil. Cover soil is frequently deposited with an earthscraper. A layer of soil loosely spread from the scraper box may be compacted to half its original thickness by the passage over it of the rear wheels of the machine. Bulk densities in the order of 2.0 g/cm^3 in the wheelings are common compared with 1.2 g/cm^3 in the loosely spread soil (7) between the wheels. The end product of such spreading is a series of horizontal layers of more or less loose soil, with intervening compacted zones. These have been shown to restrict penetration by roots and the downward movement of water.

Avoiding or eliminating these compacted layers is vital to good soil reclamation. Soil should be spread only when it is dry, using alternative earth moving machinery to the normal earthscraper. Dragline excavators, bucket-wheel excavators, forward acting shovels and dumper trucks have been proposed but entail costs considerably higher than earthscrapers (8). Until the industry is prepared to accept these greater costs, earthscrapers wil' continue to be the most common tool used and means will have to be used for overcoming the compaction they create.

If several different soils are to be used in the final 60-90 cm of cover material, they should be mixed together and spread as a unit, not in separate layers. Spreading soil in a thick layer will promote less overall compaction than spreading in several thin layers. Water movement and root growth will also be less restricted in the former method.

If soil must be spread in the conventional manner and bulk densities are above 1.7-1.8 g/cm^3, consider the following procedures designed to promote better root growth and soil water flow thereby ultimately providing a more successful reclamation project.

Preparing Compacted Soil for Plant Growth

The destruction of the compacted layers by means of subsoiling or deep-tine ripping after the full thickness of soil cover has been replaced is not usually completely effective because the available machinery cannot draw the tines deep enough or close enough together or the operation has been performed at too high a soil moisture (8). There has been some success with ripping each layer after it is spread and with the use of specially designed subsoilers. A vibrating subsoiler and the double-digger may be useful, but they are currently only being tested for their usefulness in aiding landfill reclamation projects (9).

Soil structure can also be improved by establishing a grass or ground cover (e.g. tall fescue, rye grass, crown vetch) for several years before planting trees and shrubs. The processes of freezing and thawing, rainfall, earthworm activity, soil and insect activities, percolation and leaching will also help increase soil porosity and promote more desirable soil physical properties. This process of reestablishing the network of pores and fissures by which the soil drains, may take many years. Thorud and Frissell (10) report that after artificially compacting a sandy loam from 1.14 to 1.45 g/cc bulk density in the 0- 7.5 cm depth, recovery to original bulk density occurred within 8.5 years but no recovery was recorded for deeper layers even after 8.5 years.

Organic amendments are beneficial to the physical, chemical and biological properties of most cover soil. Addition of these materials will reduce the soil strength and increase water infiltration and retention. Some organic materials provide an energy source and improve the environment for beneficial soil microorganisms and other fauna. These organic materials may include humus, peat moss, manure, crop residues, food wastes, logging wastes, industrial organics, leaf compost, composted sewage sludge or refuse compost. Gypsum, perlite or vermiculite may also be disced or chiseled into the existing soil but it is best if they are incorporated into as deep a soil layer as possible, preferably at the time the soil is originally spread on the landfill.

Fertilizing and Liming

Soil tests for pH and the major nutrients: nitrogen, potassium, and phosphorus; soil conductivity and, where possible, for the other macro and micro-nutrients should be made in a number of areas within the proposed tree planting site. Samples should be collected from a 0 to 20 cm deep soil column over a large area in a cross or zig-zag pattern. Heterogeneity in soil can be overcome by collecting several (5) subsamples over an area and pooling these to form a single composite sample. Replicate composite samples should be collected at each location. For routine soil nutrient-level surveys, any of a number of soil auger types may be used to obtain samples. The State University will help to interpret the results and make recommendations for the addition of fertilizer and/or lime. However, where trees and herbaceous species are seeded together, the rapid vigorous growth of the herbaceous vegetation in response to fertilizer may suppress or prevent establishment of seeded trees.

Heavy Metals

Soils which contain high concentrations of zinc, copper, manganese, iron, cadmium or lead should not be used for cover material unless this situation can be corrected by increasing the pH to a level not exceeding 7.0. There are several publications which discuss metal contents of soils in relation to plant growth (11, 12).

Soil Moisture

Soil moisture content of landfill cover soil will be considerably lower than the same soil on a nonlandfill area (13, 2). The factors contributing to this include thin cover soil, low organic matter content, lack of established capillary pore space, extreme micro-climates of most landfills, higher leaf transpiration rates than in nonlandfill areas, and less infiltration of rain and irrigation water due to the highly compacted nature of the soil and in some cases, sloping ground. Drought resistant tree and shrub species frequently seed themselves on completed landfills and can also draw more moisture from the soil at low moisture contents (e.g. 8% moisture content, dry wt. basis for a sandy loam) than drought sensitive species (14, 15).

Many different types of organic matter are listed in the compaction section of this manual which will increase water holding capacity of the soil. Mulching with wood chips, bark, saw dust, grass clippings, plant debris or plastic can help control evapotranspiration by reducing soil temperatures, weed growth and evaporation from the soil surface. More irrigation water will be required to maintain plantings on a landfill than on a nonlandfill area even if these policies are implemented. An above-ground irrigation system will require less maintenance than an in-the-ground system which will require continual maintenance because of breaks caused by settlement.

Erosion Control with Herbaceous Species

Mixtures of annual and perennial species are best suited for quickly stabilizing soil and protecting against erosion on disturbed land. The annual plants provide a quick temporary cover succeeded by a more permanent perennial species. Grasses and legumes should be selected on the basis of local climate and desired end use. Seeding rate recommendations should be followed carefully for the quick cover species because higher rates could produce dense stands that prevent or retard establishment of the permanent species. Contact your State University for specific ground cover species and planting technique recommendations in your area.

SELECTING TREE AND SHRUB MATERIAL

Slow-Growing vs. Rapid-Growing Species

There is evidence that slow growing trees are more tolerant to landfill conditions than rapidly growing species (6). Faster growing trees generally draw more moisture from the soil than slow growers and would, therefore, require more irrigation than the latter in order to maintain growth comparable to that on a nonlandfill area. However, if you are not concerned about how rapidly the trees will grow on the landfill compared to a nonlandfill area, then a faster growing tree may be more desirable, because it will generally provide a vegetative cover more quickly.

Small vs. Large Plant Material

Trees planted when small (1 m tall) showed significantly better growth on the landfill than those which were planted when larger than 2 m tall, regardless of species (6). Our data point out that this is related to the ability of a small tree to adapt its root system to the adverse environment in cover soil by producing roots closer to the surface (i.e. away from the higher landfill gas concentrations deeper in the soil). Roots of larger trees, on the other hand, start at a much deeper level and sometimes cannot develop adequate growth toward the surface before being killed by landfill gases. Our data (6) indicates that by the time the larger tree adjusts to the landfill by producing a shallow root system, the smaller specimens, which started with a shallow root system, can actually grow to the size of the larger trees and in some cases, surpass them. If trees taller than 1.5 m are necessary, plant them on a raised bed as to allow for shallow root development.

Volunteer Species

Although we have not specifically studied early successional volunteer tree species on landfills, they are generally very adaptable to poor soil conditions. Information on volunteer species can be found in several texts (16, 17).

Natural Rooting Depth

Tree and shrub species which enjoy a shallow root system were found in our studies to be significantly more adapted to landfill sites than species requiring a much deeper root system (6). The deeper roots are subjected to higher concentrations of landfill gases and lower concentrations of O_2. Some species can avoid this adverse gas environment by producing a shallow root system, otherspecies grow poorly because they are unable to produce shallow roots. Observations at the South Coast Botanical Garden in Palos Verdes, California, a former 87-acre landfill site, showed that shallow-rooted plants seldom were affected by landfill gases, but on some occasions there had been root damage to the larger deeper-rooted trees and shrubs (1). Several texts showing natural rooting depth of woody species are available (16, 17, 18).

The fact that trees growing on landfills generally develop shallower roots than the same species growing off the landfill emphasizes the need for more frequent irrigation of landfill soils planted with woody vegetation than comparable nonlandfill areas. In our studies at the Edgeboro Landfill in New Jersey, species excavated for extensive root studies on the landfill had a significantly larger portion of their root system in the top soil layers than in the deeper layers. However, roots were much more evenly distributed vertically on trees growing in the nearby nonlandfill control area. Deep-rooted vegetation can grow well on a landfill only if landfill gas does not migrate into the cover soil where trees are growing and provided adequate soil (90 cm or greater) is supplied to the area.

Flood Tolerance

Our field data indicates that the changes produced in landfill covers by gases are similar to those imposed by the flooding of soils; however, the high moisture content is lacking in the landfill cover soil. Therefore, species which are resistant to "wet feet" (flooding) conditions may do well on landfills only if they are supplied with adequate water. Dry site species should be planted if water will not be readily available on the site.

Size of Plants at Maturity

Another factor to consider when selecting species for landfills is size of the tree at maturity. If the cover soil is relatively shallow (30-60 cm), then choose a tree which remains relatively small at maturity or risk tree toppling during high velocity wind storms. If a deeper soil cover is used (>1 m) then the risk of windthrow will be diminished because the root system has adequate soil space to produce anchor roots, provided landfill gases are kept out of the cover soil and the trees are irrigated. There are a number of publications available which contain information on tree height at maturity (17, 18, 19). Local nurseries, landscape architects and the State University can provide information for your particular locality.

Mycorrhizal Fungi

Mycorrhizal fungi in association with plant roots have been shown to greatly increase water and nutrient uptake by the plants (20). This symbiotic association has been successfully used in coal strip-mine reclamation. Mycorrhizae may also aid in successfully establishing vegetation on completed dump sites since landfill cover soil frequently has a poor capacity for holding nutrients and water. Spore and mycelium inoculated soil has been tested for its ability to promote mycelium development on trees in landfill cover soil. Results indicate that both forms of inoculation may be viable alternatives to planting trees in uninoculated soil (21). The roots may be inoculated directly before planting, thus increasing the likelihood of successfully establishing the beneficial mycorrhizal relationship.

Pathological (Disease) Considerations

The selection of trees, shrubs or grasses should always be based on the ability of the species to withstand attack by damaging diseases or insects common to the given area. The State University can frequently provide valuable practical information concerning disease and insect-resistant plant material, optimum planting time, proper fertilization and other soil amendments critical to a disease control program.

PLANTING AND MAINTAINING VEGETATION

Trees, shrubs and grass survive best if planted in early spring or fall. Check with your Cooperative Extension Service County Agent for the planting time that is best for your area. Do not plant in the summer. Plants purchased from a nursery and delivered to the site should be planted as soon as possible. Bare-rooted material can dry out in a matter of hours if left in the sun. Balled and burlapped material can be left for longer but must be irrigated within a day or two, depending on the weather conditions.

A planting-hole about twice as wide as the root mass diameter and up to 15 cm deeper than the deepest root is well suited for trees and shrubs. Care should be taken to avoid compacting the sides of the planting hole, as this may promote prolific root growth inside the original hole but inhibit root penetration into the surrounding soil.

If you find that the soil in this hole is in the anaerobic condition (see Table I), then the plant should not be planted here. Another hole should be dug some distance away from the original location and this soil checked for anaerobiosis. Plant the tree in this area if the soil is aerobic.

Mix some of the original cover soil with some loamy textured material, preferably a highly organic soil, and spread enough of it in the bottom of the hole to make a 15 cm layer. A 50:50 mixture would be a desirable combination.

Hold the main stem of the tree or shrub and fill in around the root system until the hole is half-filled. Gently press the soil down with the sole of your shoe. Do not pack it down. During the backfilling process, be sure not to relocate the roots at a different depth from their original depth in the nursery. This can usually be determined by letting the roots hang freely before planting. Do not compact all the roots at the bottom of the hole. Spread them out as much as possible. At this point, the soil should be watered so that the entire root system has been moistened. This may take one to several gallons. When the water has all soaked into the soil, fill the rest of the hole with the soil mix and gently press the soil down with your foot. Form a circular depression around the stem with a diameter about equal to the extent of the root system. Fill this well with water until it is about to run over the ridge. These simple procedures, if carried out for all plant material, will retain all possible moisture from rainfall and irrigation and help trees survive through the most critical first season.

Irrigation is an extremely important requirement for establishing and maintaining healthy plant material on former sanitary landfills, particularly during the first 2-3 years after planting. After this time, roots may have established a large enough system to withstand moderate drought periods; however, irrigation should be practiced during extended hot, humid weather even for large established trees. This additional watering is recommended since roots on the landfill will be located close to the soil surface where there is little available soil moisture during extended dry periods. We do not recommend constructing an in-ground irrigation system since settlement is likely to cause frequent breaks in the pipes, requiring continual repair, thus increasing maintenance costs. Various above-ground expandable-joint systems are available.

Plants should be treated for disease and insect infestations and protected from damaging animals. Several animals enjoy chewing the bark of certain species during the winter. Check with the county agent and nurseryman to see if the species which were selected are susceptible to such attack. Some species are particularly susceptible to winter desiccation. Your County Agent can recommend procedures for overcoming this problem. There is at least one good text available with excellent coverage of tree maintenance (19).

GAS EXTRACTION

Extracting gas from within the refuse fill by an induced exhaust system, as is currently being practiced in several states and abroad, should aid in plant growth by reducing the quantity and pressure of the landfill gas generated in the refuse. Extraction should be compatible with establishing vegetation on completed landfills. However, commercial extraction operations are likely to end before the generation of gas has ceased, because extraction will become economically unfeasible after a number of years of operation. Even so, it may be desirable to continue running the extraction equipment, since there is likely to be enough biodegradable material left in the refuse to generate gases in concentrations harmful to plant growth. Undoubtedly the plants have established themselves in soil which most likely had a very low landfill gas content during operation of extraction equipment, and if the pumps are turned off, the gas content in the root zone environment may increase sufficiently to cause plant death.

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OUTLINE

HAZARDOUS WASTE LEACHATE MANAGEMENT

by

ALAN J. SHUCKROW
Michael Baker, Jr., Inc.
Baker/TSA Division
Beaver, Pennsylvania

I. Introduction
  A. Nature of problem
  B. Purpose of paper

II. Leachate Characteristics
  A. Sources of leachate
  B. Data base deficiencies
  C. Available data
    1. contaminated water
      a. hazardous leachates
      b. ground and surface water
    2. contaminant types
      a. organic hazardous
      b. inorganic hazardous
      c. conventional

III. Management Options
  A. Waste generation
    1. material substitution
    2. source reduction
    3. waste exchange
    4. delisting

- B. Hazardous waste treatment
    - 1. detoxification
    - 2. constituent concentration
    - 3. fixation
    - 4. encapsulation
- C. Disposal site management
    - 1. liquid diversion
    - 2. segregation
    - 3. collection and storage
- D. Leachate treatment/disposal

IV. Leachate Management

- A. Off-site treatment/disposal
    - 1. publicly owned treatment works (POTW)
    - 2. hazardous waste treatment/disposal facilities
    - 3. industrial waste treatment facilities
- B. On-site treatment
    - 1. pretreatment
    - 2. complete treatment for discharge
    - 3. recycling

V. Leachate Treatment Technologies

- A. Technology assessment
    - 1. demonstrated processes
    - 2. promising processes
    - 3. minimal application processes

B. Leachate residues

1. types
2. disposal techniques

C. Cost data

VI. Leachate Treatment Process Selection

A. Selection methodology

1. treatability studies
2. theoretical approach
3. assessment criteria
4. simulation methods
5. desk-top analyses

B. Process train formulation

1. leachate variability
2. process train evaluation factors

VII. Example Treatment Process Trains

A. Leachate containing organic contaminants

1. Love Canal experience
    a. performance data
    b. process selection considerations
    c. process characteristics
2. Ott/Story site study
    a. site characteristics
    b. waste characteristics
    c. process screening
    d. treatability study results
    e. process applicability
    f. process flowsheet

3. Other possibilities
    a. concentration technology report examples
    b. biological/GAC

B. Leachate containing inorganic contaminants

1. heavy metals only
2. heavy metals including hexavalent chromium
3. heavy metals including hexavalent chromium and cyanide
4. heavy metals, ammonia, and TDS control

C. Leachate containing organic and inorganic pollutants

1. treatment sequence
2. major processes
3. biophysical treatment approach

October 15th - 3:50 - 5:00 p.m.

Use of Facilities

Moderator:	Doug Day Dept. of Works Borough of Etobicoke, Ont.
Panelists:	Frank Condlln Region of Peel Brampton, Ontario (municipal viewpoint)
	Greg Muldoon Browning Ferris Industries Baltimore, Maryland (industry views)
	Colin MacFarlane Waste Management Branch Ontario Ministry of Environment Toronto, Ontario (provincial policy)

The 3 above panelists will discuss municipal responsibilities and jurisdictions.

3RD NATIONAL CONFERENCE ON WASTE MANAGEMENT

IN CANADA

OCTOBER 15, 1981.

USE OF FACILITIES

MUNICIPAL POINT OF VIEW

Presentation By:

F. C. Condlln, M.B.A., P. Eng.,
Director,
Waste Management Division,
Regional Municipality of Peel.

INTRODUCTION:

Under the general panel subject entitled "Use of Facilities", my presentation will review the role of the "municipality" as a provider of services and facilities for the collection, haul, treatment and disposal of waste generated by the industrial and commercial sector. I will discuss the provision and use of facilities from a municipal point of view, but will include brief comments on the expected responsibilities of industry, the private hauler and the province. My colleagues on this panel will comment further on these responsibilities, I am sure. It is not my intent to discuss the "fairness" or "inequalities" of the municipal role in providing waste services and facilities. It is my intent, however, to demonstrate that the generator of waste is responsible for that waste until another party, whether it be private or public agency assumes responsibility for that waste and in this respect, the municipal role may, and I emphasize may, contribute a significant part in the provision of waste services and facilities. The major points of my discussion will include:

1) Authority, Jurisdiction and Responsibility
2) Level of Service
3) Cost of Services

Authority, Jurisdiction and Responsibility:

The authority and jurisdication of a municipality, at least here in Ontario, is derived from the Municipal Act. In some cases, the municipality, such as a Region has further specific authority derived from special legislative acts. The Municipal Act and these special Acts may require that the municipality be definitely responsible for the provisions of waste facilities and services or, on the other hand, the acts may just give the municipality the option to provide such facilities and services to any service level the municipality so wishes. Also in the case where the special act requires the municipality to provide waste facilities and services, the type of wastes to be handled are listed with the option to expand the list by by-law to other wastes if the municipality so wishes. But you must remember that the extent of this option to provide waste facilities and services and to include other wastes is further restricted by other acts and regulations. In Ontario, the Environmental Protection Act, the Environment Assessment Act and the Planning Act control the extent of and conditions applied to waste handling facilities and systems. Further controls are applied during the approval process and the public hearings and stated on the Certificate of Approval governing the facility.

Under the Planning Act, municipalities have the authority to decide the type and location of waste facilities whether the facilities are owned

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by private or public agencies. Each municipality is required to provide an Official Plan and this is developed through a process of public meetings and hearings. The Official Plan demonstrates the type and mix of landuse and development desired by the municipality and is implemented by zoning by-laws. Again, the municipality may provide a landuse for any degree of waste handling facility. If that provision is not included, anyone including the municipality, may apply for an Official Plan amendment.

Level of Service:

Based on the scope of authority that a municipality has with respect to waste handling facilities, the level of service provided by any municipality may be demonstrated by the following:

1) Official Plans:

The municipality may include a complete program for waste handling and treatment facilities, recognizing the needs of its corporate citizens that the municipality has encouraged to locate within its boundaries. This does not mean that the municipality must provide the actual facility but the Official Plan designation allows both the private and public agencies to provide the facilities if they so wish. Conversely, the municipality may not wish to provide

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Level of Service - Cont.

1) Official Plans - Cont.

any degree of program for waste facilities. Generally, the Official Plans range between these two extreme positions and it is the responsibility of the private sector to be aware of the Official Plan provisions before establishing its operations in any municipality. The type of provisions often indicates the type of industry or landuse welcomed in that municipality. If the municipality does not include certain waste facilities and services within its Official Plan, then industry producing these wastes should not attempt to locate there with the idea to change the rules later unless it is willing to proceed with the long and often expensive process to amend the Official Plan.

There is a problem, however, regarding existing industry established under the current Official Plan. This problem arises when legislation changes the requirements concerning waste facilities and the treatment of certain wastes. For instance, the practice of disposing liquid waste at landfill sites was a common occurrence. However, new regulations in Ontario do not allow liquid waste into landfill sites unless the sites are certified for liquid waste disposal. This decision often resulted in the removal of liquid

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Level of Service - Cont.

1) Official Plans - Cont.

waste disposal services originally provided by the municipality which is not in a position to provide an alternative liquid waste facility or service. As a result, producers of these liquid wastes are left with the responsibility to have their wastes properly treated and should not expect the municipality to provide such facilities as a result of requirement changes for existing industry

2) Facilities and Services:

Within the context of the Official Plan, a variety of facilities and services for waste handling and treatment may be provided directly by the municipality or by the private sector.

Generally, the sewer system is provided by the municipality. The extent of liquid waste discharged to the sewer is governed by a Sewer By-law which usually allows the discharge of liquid wastes up to a certain concentration; liquid wastes with concentrations above the by-law limits are not allowed into the sewer and are directed to other treatment facilities usually operated by the private sector.

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Level of Service - Cont.

2) Facilities and Services - Cont.

Where no sewer system is provided, the producer of the liquid waste and sewage is required to haul all of the waste to approved treatment facilities.

Depending on the municipality's intent to attract industry, the Official Plan may include provisions for the location of a liquid waste treatment plant. Although this provision for a liquid waste treatment plant is in the Official Plan, generally the municipality will not provide the actual facility but will leave that decision and risk to the private sector. What the municipality does provide, however, is an inspection program to enforce the sewer by-laws requiring all industry to meet the same basic standards of liquid waste treatment.

When it comes to solid waste, the municipality may provide both collection and disposal services. However, the collection of solid waste is usually restricted to a limited amount of waste per pickup and often the waste is required to be packaged in a certain way. These conditions eliminate most of the industrial waste from the municipal collection program, requiring industry to provide their own waste transportation.

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Level of Service - Cont.

2) Facilities and Services - Cont.

The solid waste disposal services may include sanitary landfill sites, transfer stations, incinerators and/or resource recovery plants. Each of these facilities may have a list of acceptable wastes that industry is allowed to dispose of. All other wastes not accepted at municipal facilities are the responsibility of the producer to properly treat and dispose.

3) Outside Municipal Waste:

There has been a growing trend to restrict the ingress of waste into a municipality to waste facilities located there. If the municipality owns the facility, it has the right to restrict such "outside waste" since the municipality may govern the type of waste acceptable at its own facilities by By-law. In the case of privately owned waste diposal facilities, the municipality may obtain the same control of "outside waste" by including such restrictions in the Zoning By-law agreement governing the operation of the private facility. This action on the part of municipalities is no different from a utility or licensed coporation enforcing monopolistic authority over its jurisdictional territory.

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Cost of Services:

Who pays for waste disposal facilities and services? Ultimately it is "Joe Citizen" who pays for all waste disposal although the channel of payment may be via the selling price of the product producing the waste or via taxes; usually it is a combination of selling price and taxes. The municipality may charge a disposal fee which reflects its desire to provide facilities and to attract industry. A low, partially subsidized disposal fee usually attracts industry and conversely, a high disposal fee is not too attractive. The cost and the type of facilities and services for waste disposal usually reflects the degree of sophistication and level of service desired by the municipality. The source of this desire is derived from the voters who ultimately pay for the waste disposal service whether it be by increased product prices or increased taxes.

Closing Comments:

The municipality has a wide scope of authority with respect to the provision of waste disposal facilities and services. The desire to attract industry may be reflected in the Official Plan provisions for waste disposal, both liquid and solid wastes, and in the disposal fee schedule. The voter has the right to decide the quality of life for the municipality and ultimately pays for that right. Therefore it is the responsibility of the waste generator to "shop around" for the best combination of services and facilities,

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Closing Comments - Cont.

privately or publicly owned before establishing a production plant.

Thank you for the opportunity to present the Municipal Point of View on this controversial topic of "Use of Facilities". After my colleagues on this panel have presented the private and provincial points of view, I will gladly answer any questions.

Thank you

October 16th - 8:45 - 10:15 a.m.

Waste Management Technology "Soft"

Moderator:	Debbi Orchard ECO/LOG Week - Corpus Don Mills, Ontario
Panelists:	Philip Gandon Goodwill Toronto, Ontario (waste reduction through philanthropy)
	Lou Romano Public Works Dept. City of Windsor, Ontario (composting)

3rd NATIONAL CONFERENCE ON WASTE MANAGEMENT IN CANADA

TORONTO, ONTARIO, OCTOBER 14-16, 1981

LOEWS WESTBURY HOTEL

Panel Subject:	Waste Management Technology "Soft"
Time and Date:	8:45 a.m. - 10:15 a.m., Friday, October 16, 1981
Moderator:	Debbi Orchard - Eco/Log Week Don Mills, Ontario
Presentation by:	J. Philip Gandon - Executive Director Goodwill, Toronto.

We have not thought of our work at Goodwill tradionally in terms of Waste Management. And yet when I was asked to make this presentation I was forced to give serious thought to that term - "Waste Management." I soon came to the conclusion that it's not a bad term to describe our activity. The term we normally use is "Vocational Rehabilitation" - a term not in current usage in your everyday working experience.

Put very simply "vocational rehabilitation" means that we take men and women who for any reason - physical, mental or emotional - have been unable to secure or maintain employment, and assist them to find their rightful place in the labour market.

The raw materials we use to achieve this end are the discarded household items that might otherwise find their way into what you would describe as waste. I refer to a great variety of material for which a householder has no further use, including furniture and electrical appliances, clothing and dishes, toys, bicycles, radios and TVs. Many of these items are donated to us because they no longer work, and their repair provides the opportunity for us to provide both training and employment to disabled men and women. Once repaired and renovated they are sold in our chain of retail outlets, and the revenue from these sales enables us to pay the wages of our workers. The majority of those who complete their training with us are able to gain employment in the competitive labour market.

It seems to me that there are two ways in which this might be described a "Waste Management." First, we are taking waste materials from households, and rather than dumping it, are giving it a new lease on life. Secondly, we are taking "wasted" lives and giving them new opportunities and new beginnings.

Let me deal with some of the questions which may be of particular interest to you in your work.

What types of material do we accept, and what amounts are we talking about? We will accept almost any household furnishing and clothing. Wooden and upholstered furniture, all types of electrical appliances, large and small, lawn mowers, bicycles, toys, games, dishes, all types of clothing, drapes, bedding. We pick up approximately 350 tons of material per week.

How do we collect the material? We make an average of 300 house calls per day in response to telephone calls from householders, and we have over 300 collection boxes located on shopping plazas throughout the community. These boxes naturally generate mostly clothing and smaller items, whereas furniture and large appliances are picked up at homes.

What happens to the material? I have described the way in which all usable material is the basis of our training and employment program, and it is ultimately sold in our 17 retail outlets. Clothing that is not suitable for sale is baled into 1,000 lb. bales and sold to salvage merchants who arrange to pick it up at our dock. Metal salvage is sold to appropriate dealers. This leaves certain items that are unusable - upholstered furniture with broken frames, TV cabinets, badly soiled mattresses and other miscellaneous items that are beyond our capacity to repair or sell. These are transported by one of our trucks to a municipal disposal site each day. The significant thing here is that the amount of material going to the disposal site has been greatly reduced due to our careful sorting and putting to new use the vast majority of that which we collect. It may well be that out of your experience you may be able to indicate to us either other ways for us to generate the raw materials for our business - or additional ways that we might put to use some materials we don't presently collect. It seems to me that to the degree that we can expand our operation we are both contributing positively to the challenges faced by you in the management of waste. And I would certainly be delighted to hear from you any suggestions that may be to our mutual benefit.

Goodwill has affiliated organizations which provide a similar service in the following cities in Ontario - Hamilton, Windsor, London and Sarnia, as well as other Canadian cities such as Edmonton, Vancouver and Victoria.

So that you can see for yourself the activities in which we are engaged - in our unique management of waste - I have brought along our most recent audio-visual presentation, after which I will be glad to respond to any questions you may have.

August 14, 1981.
JPG:pm

COMPOSTING SEWAGE SLUDGE
BY MEANS OF FORCED AERATION
AT THE
WEST WINDSOR POLLUTION CONTROL PLANT
WINDSOR, ONTARIO

by

Louis S. Romano, P.Eng.

Director of Pollution Control

Department of Public Works
Corporation of the City of Windsor

3rd National Conference on Waste Management in Canada

Toronto, Canada
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CITY OF WINDSOR

1.0 INTRODUCTION

This presentation will outline how and why a composting process came about in the City of Windsor.

The City of Windsor operates two sewage treatment plants. The easterly Little River Pollution Control Plant is rated at 8 MGD and is conventional secondary. The West Windsor Pollution Control Plant has a present capacity of 23 MGD and uses physical-chemical technology.

The Little River Pollution Control Plant has disposed of approximately one-half the sludge produced to a private free-enterprise composter for over 12 years. The sludge produced at Little River Pollution Control Plant is extremely low in toxic heavy metals and the finished product is sold in various forms of soil conditioner in both Ontario and the State of Michigan under the name of "Grow Rich". The remainder of the sludge was disposed of at the City's Sanitary Landfill, as was all of the sludge produced at the West Windsor Pollution Control Plant.

In the summer of 1973 the sanitary landfill sites in the City of Windsor were closed for the disposal of refuse and sewage sludge, and arrangements had to be made at that time with a neighbouring municipality for the disposal of these wastes at a county landfill site some 25 miles away. Needless to say, the cost of disposal has increased substantially.

The City administration began to look for alternative ways of disposing of sewage sludge and especially a recycling program if it could be economically feasible.

The City reviewed the compost process that was used by the commercial composter to treat the Little River Pollution Control Plant sludge. This process used the windrow method, and required extensive land which was not available in the City, with a sufficient buffer zone.

Heat treatment and incineration were evaluated, and the capital and operating costs were found to be prohibitive for the size of the City's two plants. It appeared as if continued landfilling was the only viable alternative though not necessarily the most desirable. Then the aerated rapid composting process, that was developed by the United States Department of Agriculture at its research laboratories in Beltsville, Maryland, came to the attention of the City Administrator in 1976.

Several field trips were made to Beltsville to obtain firsthand information on the process.

It was decided to evaluate the process in regards to cost effectiveness and the actual results obtainable from the sludge produced in Windsor. It must be remembered that sewage treatment sludge from a specific plant has different characteristics than that from another plant or location.

Experimental piles were built at the West Windsor Pollution Control Plant in 1977 with the invaluable assistance of Dr. E. Epstein who was retained as a consultant for the City. The trials used straw, corncobs and wood chips as the bulking agent to be mixed with the sludge.

The small trials proved that the U.S. D.A. aerated method using wood chips as a bulking agent worked very well in Windsor. The projected costs of composting were still 10 to 15% more than haulage and burial at the county landfill. However, this did not take into account the value of the finished compost, or if indeed there was a firm market for the compost. Also the capital cost of landfill acquisition was not considered.

At this time in early 1977, Windsor City Council had decided that one of the closed landfills in the City's west side was to be converted into a park and golf course. The cost of obtaining sufficient topsoil to convert the approximate 160 acre site to a park was estimated at $500,000 minimum.

It was estimated that the composting process at the West Windsor Pollution Control Plant would generate approximately 10,000 cubic yards of compost per year. It would take ten to fifteen years to generate enough material for the park requirement. The park development had converted the composting idea into a reality.

2.0 SITE

The plant chosen for composting was the West Windsor Pollution Control Plant for the following reasons:

A. There were six acres on plant site that could be used for composting for at least ten years.

B. The compost site was 1,100 feet away from the nearest houses.

C. This was the largest of the two plants and the greatest benefit would accrue in both scale of operation and removal of sludge haulage from City streets.

D. The site could be economically drained to sanitary sewer.

The plant produces approximately one ton of dry solids, in sludge, per million gallons of flow treated. The primary/chemical sludge is pumped from the clarifiers to the dewatering building where vacuum filters and a centrifuge serve as dewatering devices. The raw sludge has a solids content of approximately eight (8) percent which is increased to 26 percent when dewatered by centrifuge and to 20% when dewatered by vacuum filter. Approximately 35,000 tons of wet sludge cake require disposal.

Before commencing site preparation it was necessary to gain approval from the Provincial Environmental Assessment Board. Conditional approval was given by the Board with the stipulation that monitoring of compost, both during its preparation and as a finished product, be undertaken on a regular basis for the determination of pathogenic organisms and heavy metals, and that off-site monitoring also be implemented with respect to application of compost on public property.

3.0 SITE PREPARATION and EQUIPMENT

The main reason that the compost process was economical was that the capital cost required to set up for this process need not be high. In our case $50,000 provided the compost site which is located on plant property with complete field tiling of five acres. The tiles drain into a sewer going back to the Pollution Control Plant. Any leachate and all run-off water is thereby treated. In addition, a 100' x 150' concrete pad was constructed; all drainage again is directed to the treatment plant. The final site preparation was running an electrical power line to light the area and provide power for the aeration fans. Accordingly, a triplex powerline carrying 120/208 volts was erected on five regular hydro poles. At each pole are four duplex receptacles, each having its own 15 amp. breaker at the motor control panel.

The major equipment consists of large front-end loaders; the materials are light and our standard three cubic yard front-end loaders are equipped with five yard buckets. The loaders should have the highest lift possible; in Washington, D.C. they are equipped with hydraulic extension arms allowing a 12 foot dump clearance. This allows a higher and therefore larger pile per square foot area. This saves on space and materials for the base and suction piping. The other piece of eqipment at West Windsor is a tractor and rototiller.

4.0 COMPOST PROCESS

The process in abbreviated form is as follows:

i. The wood chips are laid out on the mix pad.

ii. The mechanically "dewatered" sludge is hauled from the plant and spread on the wood chips - the front-end loader evens the entire mass.

iii. The rototiller mixes the wood chips and sludge.

iv. Then the front-end loader collects the mixture and in turn gives it a further mix by placing the mix at the end of the pad.

v. A base is provided of clean wood chips with its suction piping spaced every eight feet apart. Three sections of pipe are connected to a fan capable of draining 300 C.F.M. at a static pressure of 4".

vi. The mixture is placed on the base by the front-end loader assuring that there are no voids (plastering).

vii. When sufficient mixture is placed, a blanket of cover compost is placed for insulation purposes.

viii. Cross-section of the pile (Figure 1).

ix. The suction piping is connected to solid but flexible plastic pipe which has a drainage tee. The leachate that is drawn out is directed to stone drains leading to the drainage tile.

x. The suction piping is then connected to the fan which is run on a timer that can be variably adjusted by increments of two minutes. Usually the fans are run four minutes on and four minutes off.

xi. The air discharged from the fan is very odourous and it is necessary to scrub the air of the malodourous substances. This is accomplished by diverting the air into a scrubber pile made up of screened finished compost. The compost removes all the malodourous elements of the air discharged by the fan.

xii. The compost piles are stacked or built in series with no space between them. This results in better temperatures and conserves on site space. In addition there is less cover material needed.

xiii. The curing piles are monitored for oxygen and temperature. Now that sufficient experience has been obtained, the oxygen monitoring is only done on a periodic basis. The temperature must reach 55°C or 130°F throughout the pile for five successive days in order to completely destroy harmful pathogenic bacteria and virus. At West Windsor the normal average temperature of the piles is 68°C or 150°F. Generally, most of the curing pile cross-section (Figure 1) reaches 72°C or 160°F for a period of over two weeks (Figure 2).

xiv. The curing pile is broken down after 30 days of composting. The material is still very warm and a significant amount of moisture is given off as the loader moves the material

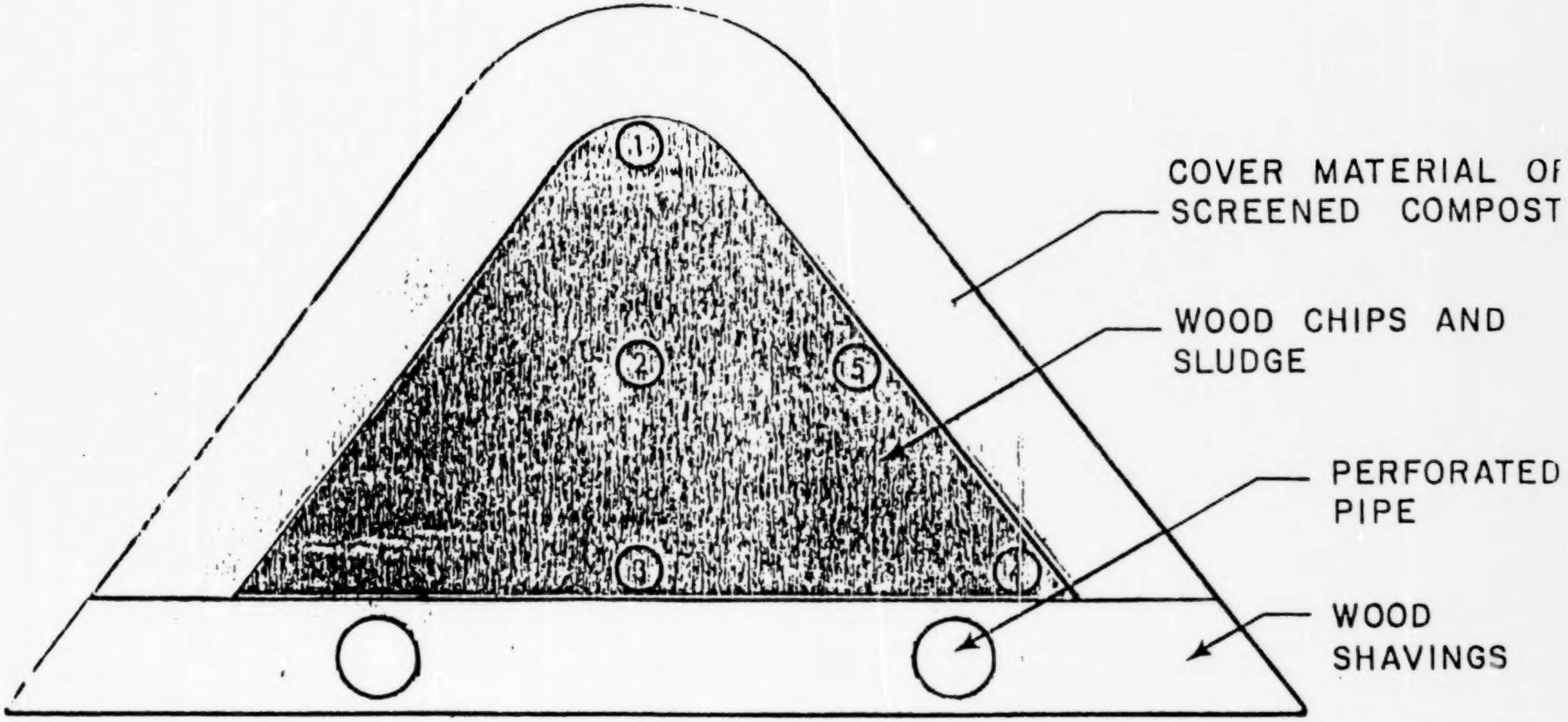


FIG. 1

CROSS - SECTION OF A COMPOST PILE SHOWING TYPICAL SAMPLING POINTS

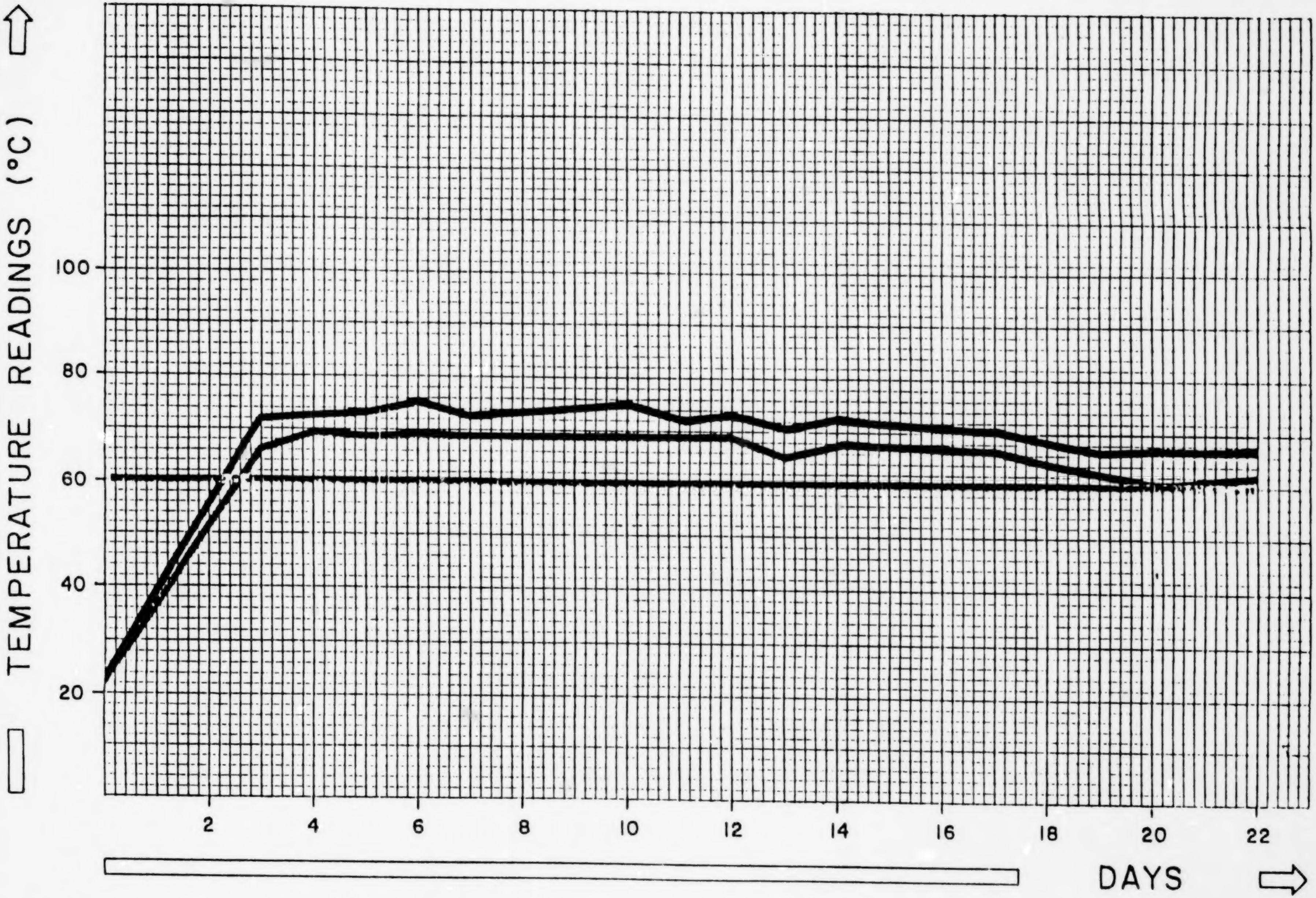


FIG. 2:

AVERAGE & LOW TEMP. RDGS. WITHIN WELL INSULATE
PILE

to a location near the screen. The mixture is dropped from the raised bucket of the front-end loader in order to expose as much of the compost to air as possible. The hot compost loses two to three percent moisture by this manoeuvre.

xv. The compost is then screened in order to recover 80% of the original wood chips in the mixture. The type of screening equipment is critical to the whole process, as improper screening plants can almost totally bog the process down if the end step does not keep up with the composting. This is a complete exercise in material handling and this paper does not have the scope to enter into this matter in detail. If anyone is interested in this facet, the Public Works Department staff will be pleased to discuss this in detail at a later date.

xvi. The finished screened compost is an earth-like material with fine wood slivers in it. The screened compost or final product has a composition as shown on Table I and II. Table I gives a comparison of chemical composition of sludge cake with screened compost. It will be noted that while there is a substantial drop in moisture content in the final product, there is also a slight reduction in nutrient content. Compost cannot be considered to be a fertilizer because of low levels of nitrogen, phosphorus and potash. Table II exhibits the heavy metal content in compost and the proposed provincial and federal guidelines of maximum acceptable metal concentration in compost containing 5% nitrogen or less.

5.0 COST

The cost to compost the sludge cake for the West Windsor plant is slightly less than $11 per ton. The expenditure to haul and bury the sludge cake at the county landfill is approximately $9 per ton.

6.0 COMPOST USE

In Windsor it is projected that the total compost produced will be consumed by the Parks Department and the Public Works Department for

CITY OF WINDSOR

COMPARISON OF CHEMICAL COMPOSITION OF SLUDGE CAKE WITH SCREENED COMPOST.

CONSTITUENT	SLUDGE CAKE	COMPOST
SOLIDS	23·4 %	65·7 %
VOLATILE (% OF DRY SOLIDS)	56·3 %	32·9 %
AMMONIA - NITROGEN	0·16 %	0·26 %
KJELDAHL- NITROGEN	2·7 %	1·3 %
PHOSPHORUS AS P	2·0 %	1·8 %
POTASSIUM AS K	0·04 %	0·05 %

NOTE: TEST DATA REPRESENTS AVERAGE VALUES OF COMPOSITE SAMPLES OF SLUDGE AND COMPOST ANALIZED IN 1979

TABLE II

CITY OF WINDSOR

HEAVY METALS IN SLUDGE COMPOST WITH RESPECT TO ENVIRONMENTAL GUIDELINES

CONSTITUENT	COMPOST	PROP. PROVINCIAL GUIDELINES	PROP. FEDERAL GUIDELINES
CADMIUM	9·8mg/kg	3·5 mg/kg	10 mg/kg
CHROMIUM	418 "	490 "	1,100 "
COPPER	412 "	375 "	850 "
NICKEL	346 "	80 "	180 "
LEAD	302 "	210 "	500 "
ZINC	1,960 "	810 "	1,850 "
MERCURY	2 "	2 "	5 "

park development and restoration; the Public Works Department will use the material for right-of-way restoration. The City's golf course will be trying the compost on some of its fairways this fall. Presently they are purchasing dried commercial humus material to add to the fairways at the end of the golf season.

The City has received approval for an agricultural compost demonstration from the Ontario Ministry of the Environment. The agricultural demonstration will be undertaken under the direction of the Ridgetown College of Agriculture and Technology. The trial will see compost produced from the West Windsor Pollution Control Plant and the Toronto Experimental Recovery Centre used on corn plots near Ridgetown, Ontario. The reason that the compost is being used is that it appears to meet the quality guidelines for agricultural use. In addition, humus material is in short supply in the cash crop area of Essex, Lambton and Kent counties. Therefore humus material, like Windsor's compost, will be in ever increasing demand in the future for agricultural use.

The City has had several requests to sell the finished compost to sod farm operations, but because of the City's internal demand, this has not been possible.

Compost as you well know is an excellent soil conditioner. In sandy soils it stabilizes the earth preventing wind erosion and adding moisture retention. Compost has been used for this quality in one of the areas in the City's Mic-Mac park. An area known as the "commons" was very sandy and grasses continually tended to die out especially in the warm dry weather. The area was treated with an average of 4" of compost and rototilled into the sandy top layer of soil. The results have been excellent.

Compost treated soil makes an excellent amenity for the quick growth of grass. There has been as yet no scientific tests in Windsor but based on the U.S. D.A. experience in the Washington, D.C. area, it has been found that sod is ready for marketing in six months, while sod produced on identical soil and properly prepared and cared for takes 14 to 15 months to mature.

Compost has been used successfully with a large cost savings by the United States National Capital Region (NCR) Parks Service and the Maryland State Parks Service. Much of the turf in the above parks receives heavy use by visitors, residents and government employees. This heavy use creates adverse impact on the ground cover and soil. Consequently, there is interest in materials which would be appropriate as soil amendments to alleviate this impact. It was found that the use of the Beltsville compost increased the infiltration of water both in intake per hour and in total intake over the three hour period by more than 50 percent. Also the quick growth of the grasses enabled the respective park departments to seed rather than sod many large areas.

Of course, land reclamation is an ideal use for this recycled compost material. As mentioned, in Windsor the Parks Department is reclaming an old landfill of approximately 160 acres. It will be converted into a golf course, active and passive recreation areas, and a toboggan slope.

The present cover material at this site consists of impervious clay which is infertile and useless from a horticulturist's point of view. The compost will take the place of over 100,000 cubic yards of topsoil. The topsoil in this quantity is not available in this area, and if it were, the cost would be in the area of one million dollars.

The Parks Department intends to spread compost on the existing cover material to a depth of 4 to 6" and then incorporate it into the clay by rototilling and discing. This may be required twice in some locations. This would equate to 640 cubic yards per acre to 1,600 cubic yards per acre. At least ten years' production of compost will be required to meet the demands of this single project.

7.0 CONCLUSIONS

(a) Composting of sewage sludge is practical in most urbanized areas in Canada.

(b) Composting is a method to treat waste (or recycling of waste) and at this point is not a significant moneymaker.

(c) By composting sewage sludge cake, the odours are alleviated and a stable humus-like organic material is produced.

(d) The exothermic process generates temperatures within the pile that effectively destroy many of the human pathogens.

(e) While composting is more labour intensive than some of the other systems of sludge cake disposal, it is not capital intensive.

(f) The composting of sewage sludge is a conserver of energy when compared to other methods of disposal.

(g) The end product can be utilized as a soil conditioner in publicly owned parks and recreational areas, and it could also be used by the agricultural industry in the production of field crops.

(h) The compost process can be readily contracted or done by City forces.

LSR:pb

October 16th - 10:40 - 12:10 p.m.

Waste Management Technology "Hard"

Moderator: Ken Childs
Waste Management Branch
Environment Canada
Ottawa, Ontario

Panelists: Brian Croft
Dome Petroleum Ltd.
Calgary, Alberta
(heat recovery incinerator economics)

Jerry Franklin
Dept. of Public Works
City of Madison, Wisconsin
(RDF plant)

HEAT RECOVERY FROM MODULAR INCINERATORS

by

B. R. Croft

ABSTRACT

The rising cost of fuel and the ever-increasing demand for better environmental controls are pushing up the cost for collection, haul and landfill disposal of solid waste. Costs are also rising in parallel to fuel prices for steam production and space heating.

The economic feasibility of switching from landfill disposal to incineration is evaluated in this paper. The analysis is aimed at determining the fuel price at which incineration/heat recovery is justified. The evaluation is not site specific but is based on representative conditions for two different applications, municipal and institutional.

Comments are made on optimizing the heat recovery facility to improve the economics. In addition, some potential problems areas, which should not be overlooked, are highlighted.

Finally, brief discussion on practical problems encountered during equipment specification and tendering is provided.

Paper presented by: Jerome D. Franklin, P.E.
Director of Public Works
Madison, Wisconsin

MADISON'S RESOURCE AND ENERGY RECOVERY PROGRAM

1981

The City of Madison, a State Capitol with a population of over 170,000, has been a pioneer in the development of municipal solid waste management practices in the United States. In September, 1967, the City began shredding municipal solid waste prior to landfilling to improve the disposal characteristics of the waste.

The City expanded its involvement in resource recovery in April, 1970, when a City-wide newspaper recovery program was instituted.

In 1972, the City entered into an agreement with the Continental Can Company to develop recovery of ferrous metal from shredded municipal solid waste stream prior to landfilling. Both the newspaper and salvage program and ferrous recovery program continue to operate today.

In 1973, the City began to analyze the utilization of the combustible portion of its shredded municipal solid waste for use as a supplemental fuel to be cofired with coal at the Madison Gas & Electric Company, an investor-owned utility, serving most of the Madison urban area. The concept proved feasible, and in 1977, the City of Madison and the Madison Gas & Electric Company entered into a ten-year agreement to fire processed municipal solid waste (Refuse-Derived-Fuel) in a suspension with pulverized coal to produce steam for electrical power generation. Based on the City's past experience in waste processing, a design team comprised of the City's Divisions of Engineering and Streets and Sanitation, and a consultant, began design of a process plant to produce Refuse-Derived-Fuel.

The design of the plant developed a processing system which would produce a high-quality Refuse-Derived-Fuel (i.e., low ash and appropriate particle size), maximize the utilization of the existing plant and personnel, minimize the capital investment requirement, and significantly reduce the City's landfill space needs. With design of the processing plant finalized, construction began in April, 1978.

Construction of the processing plant was completed in February, 1979, and in March, the first ton of Refuse-Derived-Fuel was produced. A shakedown period followed, during which time the system was debugged and operating experience was gained. There were no major modifications required to achieve the desired end products. Minor modifications and realignments were performed during the shakedown of the system. By June, when the plant was formally dedicated, the plant was processing at its design capacity of 250 tons per day.

The City of Madison and the Madison Gas & Electric Company developed the project with the intent of maximizing the utilization of existing plant and personnel, and to minimize the capital investment necessary for implementing the project. The above goals were accomplished. It is (to our knowledge) the lowest cost system developed in the United States to satisfactorily handle municipal solid waste for energy production. Further, the operation of this plant has reduced the City's landfill space needs by nearly sixty (60%) percent and the Refuse-Derived-Fuel ash content and particle size makes it one of the most effective systems in the United States. The center, built on a site previously used as a open dump burning area, received an award in recent competition conducted by the Consulting Engineers Council of Wisconsin.

The award recognized unique and innovative design concepts which made possible low-cost construction and successful operation of the recently expanded solid waste processing unit.

The City of Madison is currently completing in cooperation with Oscar Mayer Company an Environmental Protection Agency Research Grant to "test fire Refuse-Derived-Fuel in an industrial boiler." The Oscar Mayer and Company could represent a second market to the City for the use of Refuse-Derived-Fuel. Operational characteristics of the Refuse-Derived-Fuel feed system, and the reliability and practicality of receiving, storing and firing Refuse-Derived-Fuel at an industrial operation, utilizing a mechanical feed system, are being studied.

PROCESSING PLANT DESIGN

The process selected to produce the fuel required by the utility consisted of primary shredding, ferrous metal removal, separation of combustibles and non-combustibles, secondary shredding, and air sweeping.

In developing a process, the City also wished to maximize the use of the existing shredding building and to include alternate methods of processing waste in case of R.D.F. production line failure.

The developed layout consisted of independent process sytems within one process line:

(1) A failsafe stationary packer/transfer system to haul all refuse to a landfill without processing; and,

(2) Primary shredding with ferrous metal removal in which the front end of the system can be utilized to process wastes for landfilling in case the R.D.F. process line were down or the utility could not accept the R.D.F.

SEPARATION UNIT

One area which concerned the designers was the actual separation of the non-combustiles and combustibles. Experience with air classification indicated that air classification did not significantly separate glass and other non-combustible fines from the fuel fraction.

After an evaluation of existing available technologies, both experimental and operating, the City decided to develop a cooperative agreement with a private company for the installation of the separation process. The technology selected was a screening process which separates the glass, sand, dirt, and other inorganic materials from the waste prior to excessive shredding.

The City negotiated a ten-year performance contract for that system with a private company under which the company guarantees performance of the system at fifty tons per hour of input with a minimum R.D.F. output of thirty tons per hour and a maximum ash content of 15 percent (as received).

The private company paid all capital costs for the installation and is responsible for all operating expenses of the system. The City pays the company an annual fixed fee of $112,500 plus a variable unit fee per ton of R.D.F. produced.

PRIMARY AND SECONDARY SHREDDER SYSTEMS

The primary shredder was selected to meet input requirements of the separation unit to process a minimum of fifty tons per hour and produce a particle size of 60 percent less than four inches.

After the noncombustibles are removed, the R.D.F. is shredded again with the secondary shredder to meet a particle size range of 98 percent less than two inches and 90 percent less than three-fourths of an inch.

After secondary shredding, the R.D.F. is injected into an air column for final cleanup before loading into transfer trailers for transportation to the utility.

RDF RECEIVING STATION

The Madison Gas & Electric Company's pulverized coal-fired boilers are equipped with electrostatic percipitators with sufficient capacity to adequately control any increased particulate emissions as a result of firing R.D.F.

The boilers are front-fired with a spiral coal injection system, with combustion air to provide fuel distribution into the boiler. There are six coal burners located at three elevations. The bottom ash is collected in a dry ash pit prior to removal. The ash is removed via a pneumatic pipe system for silo storage prior to ultimate disposal.

The R.D.F. is scheduled to be burned over a ten-hour period, five days per week. Due to the burning schedule and the fact that the processing plant is located three miles from the power plant, a low storage capacity system was designed.

The transfer trailer is being used as the main R.D.F. storage container. In the event of mechanical failure or if R.D.F. could not be burned for other reasons, the material can easily be disposed of by being transferred to the landfill. Therefore, a relatively low-cost receiving facility was developed in which a maximum of thirty tons of R.D.F. could be stored at any one time.

HOW IT WORKS

The facility is especially impressive in its simplicity and general cleanliness. The designers paid great attention to the material handling aspects of refuse processing with an eye toward minimizing spillage and other maintenance headaches. The in-feed system consists of a simple tipping floor equipped with a rubber-tired payloader. This is used to push refuse into a pan conveyor, designed and built by a local fabricator. Refuse is then deposited onto an elevating flight conveyor which elevates it and deposits it into a flail mill.

Again, these components were designed and built by local fabricators to the specifications of the Madison Engineering Division.

REFUSE FLAILED, THEN SEPARATED

The flail is designed to spread apart the refuse, open bags, and generally loosen the material prior to further separation. It is not designed to accomplish significant size reduction.

The flail is located in a room separated from the rest of the plant by thick concrete walls. It is equipped with a blow-out roof to relieve the pressure of any shredder explosions.

A rubber belt conveyor removes the material from the discharge of the flail mill, elevating it for the first separation step, which consists of removal of ferrous metal by a rotary drum magnet located over the tail pulley of the belt conveyor. The ferrous metal is passed through a rotary crusher and an air scrubber before being discharged to the transport trailers outside the building. The non-ferrous material then passes by conveyor into the proprietary separator.

The separator divides the material into two fractions. Heavy materials such as shoes, leather, glass, nonferrous metals, etc. are discharged to a transfer trailer for transport to the landfill. Grass clippings, a major component of solid waste during the summer months, also end up in the reject fraction from the separator, thereby removing this troublesome element from the ultimate fuel fraction.

SHREDDING REDUCES REFUSE TO R.D.F. SPECS

The material from the separator destined to become R.D.F. is then conveyed to a shredder where it is reduced in size to the final R.D.F. specification. A final air classification stage removes small pieces of glass and metals before the final R.D.F. is transported to the transfer trailers for shipment to Madison Gas & Electric.

Quality control is maintained by analyzing three to five samples each day. The specification of R.D.F. calls for an ash content of less than 15 percent, (averaging 10 to 13 percent) and moisture content varies with the weather, but normally will be in the range of 25 to 30 percent. The R.D.F. weighs an average of three to four pounds per cubic foot.

The plant is operated by a manager, two foremen, a quality control specialist, two assistant operators, three men who double as maintenance men and drivers, and one equipment operator for the receiving floor.

All of the controls are located in a centralized control room from which the operator is able to see all elements of the operation, except the shredding room, either directly, or on TV monitors.

CAPITAL AND OPERATING COSTS

The final capital investment by the City for the process plant was $2.89 million, including startup costs. For the R.D.F. receiving station and boiler modifications, the City's capital cost was $1.56 million.

Using the existing structure for the processing plant and refurbishing some of the original equipment saved money. As the ferrous recovery system and the separation unit are now owned by the City, no capital investment was required there.

The 1980 annual operating cost to handle 55,000 tons of solid wastes, including processing, transporting the end products to their respective markets (R.D.F. to utility, residues to landfill) cost of firing the R.D.F., and disposal of residues and increased ash, is estimated at $28.80 per ton. Revenues are estimated at $9.36 per ton as received to the processing plant, with a net system cost of $19.42 per ton.

The process plant has been shown capable of processing up to 500 tons per day. As the City's operating capability and Madison Gas & Electric's R.D.F. firing capabilities improve, additional solid wastes will be accepted at the processing plant.

All fixed costs (i.e., amortization, fixed fees, electrical demand charge, etc.) account for approximately 54 percent (79 percent of the net cost) of the total system annual costs.

Costs will decrease as tonnage increases. If the tonnage were increased to 75,000 tons per year, the net cost would be approximately $13 per ton (1980 dollars).

COMMUNITY ATTITUDES

The response of Madison residents to the resource recovery plant has been most favorable. Knowing that the electricity consumed in their homes and businesses is in part derived from their refuse is perceived by most as a very positive result of what could be an environmental problem. The benefits being not merely environmentally sound disposal, but the increased life of our precious land-fill area.

Located within sight of the capitol dome the recovery plant is immediately surrounded by a residential area and is adjacent to the Dane County Coliseum. The reactions of the nearby neighors are generally as favorable as those of the whole community. The plant is best described as unobtrusive. There are no noticeable emissions, and no problems with insects or vermin.

Attached are some detailed breakdowns of costs and accounting data for informational purposes.

PLANT COSTS

Building & Grounds		
General	$654,662	
Mechanical	79,560	
Plumbing	89,950	
Electrical	128,776	
Site Improvements	72,028	
		$1,024,976
Process System		
Primary Shredder System	168,786	
Secondary Shredder System	919,357	
Electrical Equipment	62,485	
Miscellaneous Equipment	108,555	
		1,259,183
Other Costs		
Engineering Consultants	155,081	
City Engineering Staff (from 1/1/74 to 6/30/79)	98,944	
Plant Personnel During the actual construction period	184,580	
		438,606
TOTAL CAPITAL COST		$2,722,765
ANNUAL COST (10 Years, Interest = 5.5%)		326,560

Madison Magnetic Operation (Ferrous Metal System)	Private Capital - City received 15% of profit from the sale of ferrous
Madison Solid Waste Fuel Company (Separation Unit)	Service Agreement - Annual fee - $112,800 plus unit cost per ton of R.D.F. produced

RECEIVING STATION COSTS

Building & Grounds		
General (includes site improvements)	$199,713	
Mechanical	16,162	
Plumbing	24,130	
Electrical	42,060	
		$ 282,065
RDF Feed System		
Twin-Auger Unloader & Bins	$220,390	
Feed Conveyors	60,700	
Pneumatic Feed System	177,410	
Equipment Installation	71,859	
Electrical Equipment	14,112	
		$ 544,471
Other		
Consultants	88,135	
City Engineering	40,000	
Start-up Costs	100,000	
		$ 228,135
TOTAL CAPITAL COST		$1,054,671
ANNUAL COST (10 Years, Interest 5.5%)		136,000
Boiler Modifications (MGE Financed)		500,000
Annual Cost (10 Years, Interest 8.0%)		74,500

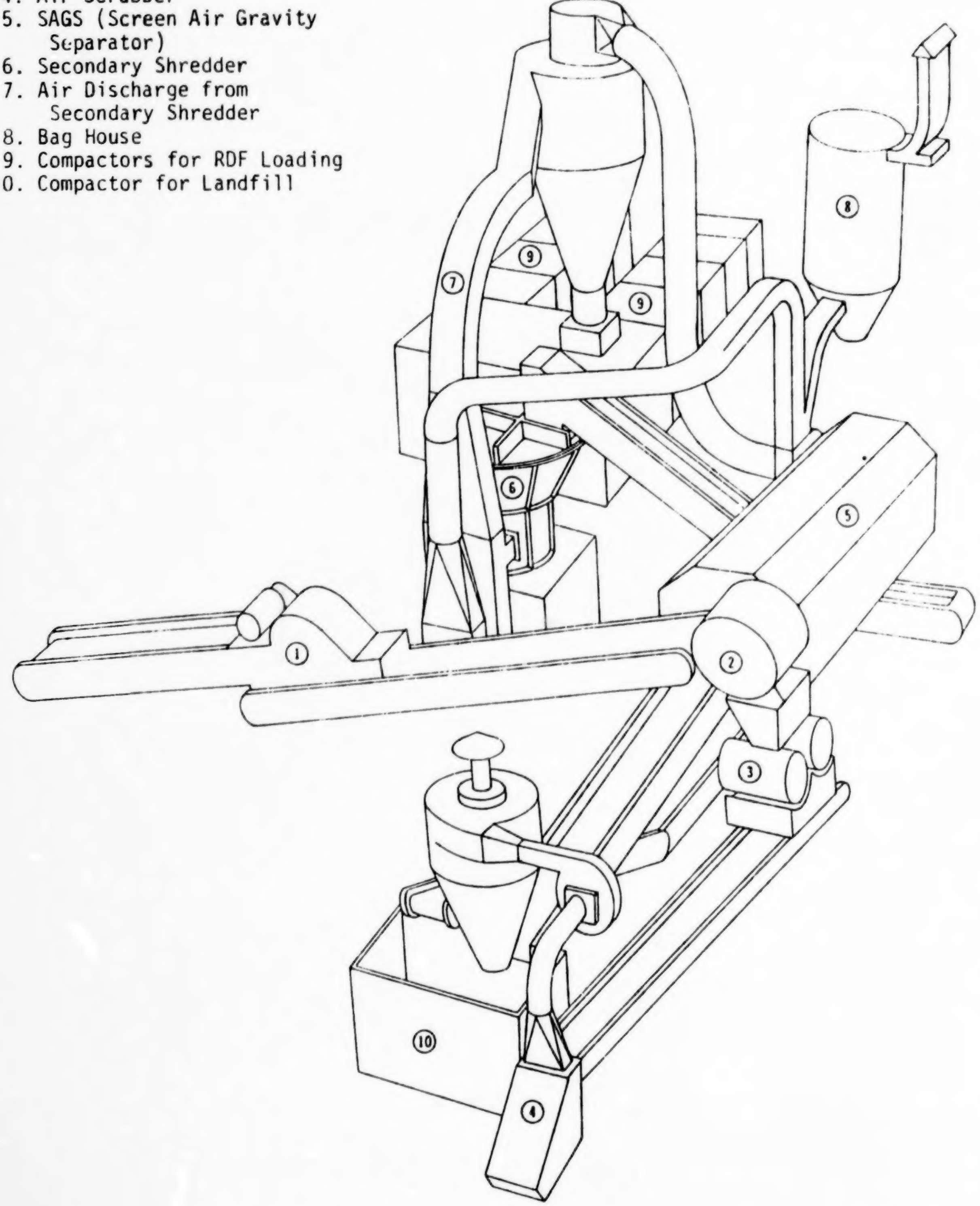
	1ST QUARTER	2ND QUARTER	3RD QUARTER	4TH QUARTER	1980 TOTALS
Revenue:					
Refuse-Derived-Fuel	$ -0-	$ 45,693.50	$ 53,751.12	$ 51,745.68	$ 151,190.30
Ferrous Metal	-0-	-0-	-0-	-0-	-0-
*MSWF Charge Back	2,128.37	2,149.26	2,259.56	2,407.17	8,944.36
**MMO Charge Back	937.33	-0-	827.55	571.65	2,236.53
Tipping Fees	1,294.02	6,117.66	7,423.65	6,886.62	21,721.95
TOTALS	$ 4,259.72	$ 53,960.42	$ 64,261.88	$ 61,611.12	$ 184,093.14
TOTAL COSTS	$358,280.11	$375,390.30	$414,404.68	$415,885.33	$1,563,960.40
REVENUE	4,259.72	53,960.42	64,261.88	61,611.12	184,093.14
NET TOTAL COSTS	$354,020.39	$321,429.88	$350,142.80	$354,274.21	$1,379,867.26
COST/TON	$ 46.85	$ 25.17	$ 25.19	$ 28.91	$ 29.69
ENTITLEMENTS	$ 47,632.93	$ 48,352.19	$ 41,314.51	$ 36,300.29	$ 173,600.64
Adjusted Total Cost	$306,387.46	$273,076.97	$308,828.29	$317,973.92	$1,206,266.62
Cost/Ton	$ 40.55	$ 21.38	$ 22.22	$ 25.95	$ 25.96

*MSWF - Madison Solid Waste Fuel Company

**MMO - Madison Magnetic Operations

SCHEMATIC DESIGN OF THE MADISON ENERGY RECOVERY PLANT

1. Primary Shredder
2. Metal Recovery
3. Densifier
4. Air Scrubber
5. SAGS (Screen Air Gravity Separator)
6. Secondary Shredder
7. Air Discharge from Secondary Shredder
8. Bag House
9. Compactors for RDF Loading
10. Compactor for Landfill



OVER VIEW OF THE MADISON ENERY RECOVERY PLANT